COMMERCIAL BANK BEHAVIOR AND THE LEVEL OF ECONOMIC ACTIVITY:

AN ECONOMETRIC STUDY

by

STEPHEN MICHAEL GOLDFELD

A.B., Harvard College
(1960)

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF
PHILOSOPHY

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

August, 1963
Professor Robert L. Bishop
Chairman
Department of Economics and Social Science
Massachusetts Institute of Technology
Cambridge, Massachusetts

Dear Professor Bishop:

In partial fulfillment of the requirements for the degree of Doctor of Philosophy in Industrial Economics I hereby submit the following thesis entitled,

"Commercial Bank Behavior and the Level of Economic Activity: An Econometric Study."

Stephen M. Goldfeld
Mr. Stephen M. Goldfeld  
Department of Economics  
M.I.T.

Dear Stephen:

On behalf of the department, I am happy to give you permission to have your thesis printed instead of typewritten, in accordance with the Institute regulation on page 45 of the Graduate Student Manual (September, 1962).

Sincerely yours,

Signature redacted

Robert L. Bishop  
Head, Dept. of Economics and Social Science

RLB:af
ABSTRACT OF THESIS

COMMERCIAL BANK BEHAVIOR AND THE LEVEL OF ECONOMIC ACTIVITY:
AN ECONOMETRIC STUDY

Stephen M. Goldfeld

Submitted to the Department of Economics and Social Science on August 20, 1963, in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

This thesis examines the behavior of the commercial banking sector in the United States in the postwar period. In particular, we investigate this behavior within the context of a minimally complete aggregate model in order to examine the interaction of the monetary sector with the remainder of the economy.

The first chapter advocates the treatment of the supply of money as an endogenously determined function of bank liquidity decisions and presents a brief illustration of the approach adopted in this thesis. Chapter II begins with a general discussion of bank liquidity and then investigates the disaggregation of the model with respect to the various components of bank portfolios and with respect to the Federal Reserve member bank classificatory scheme. The remainder of the chapter is devoted to an examination of bank holdings of excess reserves, borrowings, and short term securities, and to the supply of commercial and industrial loans. In each of these last four sections we present some preliminary single equation tests of the respective equations.

Chapter III, broadly speaking, investigates the interaction of the monetary and real sectors. In particular, we examine the demand for commercial loans and the demand for inventory and fixed investment. The discussion of plant and equipment introduces a long term interest rate into the investment demand equation, and consequently the final section of this chapter is devoted to a discussion of long term interest rates. As above, the discussions in each of these sections are supplemented with some preliminary single equation estimates of the various equations.

The earlier results of this thesis are integrated in the fourth chapter which begins by presenting a more specific determination of the supply of, and the demand for money. Following the derivation of a simple income determination equation, we then complete our econometric model. The results of the
two stage least squares estimations are then presented, and we conclude this chapter with a discussion of the results. Among the major findings was the significant behavioral differences found to exist between country and city banks. A second finding of interest was the broad role available to open market operations in influencing bank asset choices and various interest rates.

Chapter V presents some brief comments on the results of general interest and then indicates some suggestions for future research.

Thesis Supervisor: Albert K. Ando
Title: Associate Professor of Economics
ACKNOWLEDGEMENTS

My greatest debt of gratitude is owed to my thesis supervisor, Professor Albert Ando, who patiently guided this study to completion. His numerous suggestions, particularly those directed towards troublesome points in this investigation, proved invaluable and have added significantly to the final product. In the course of various discussions Professor Edwin Kuh has also made many useful comments.

I wish to express my thanks to the Ford Foundation for generous financial support during the writing of this thesis through a fellowship under their doctoral dissertation program.

I am also indebted to David Kresge who greatly facilitated the computation of the structural estimates.

I owe a special debt of gratitude to my wife, Laura, who, with good spirits, put up with the thesis vigil and who provided extensive editorial assistance during the final stages of preparing this manuscript. Finally, I should like to acknowledge Melanie Dawn whose complete disdain for the two A. M. feeding greatly speeded up the entire process.
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. INTRODUCTION</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>B. Illustration of Approach</td>
<td>4</td>
</tr>
<tr>
<td>II. BANK LIQUIDITY: THE BASIS FOR A MONEY SUPPLY</td>
<td>9</td>
</tr>
<tr>
<td>FORMULATION</td>
<td></td>
</tr>
<tr>
<td>A. Liquidity and Uncertainty</td>
<td>10</td>
</tr>
<tr>
<td>1. Bank Loan Portfolios</td>
<td>15</td>
</tr>
<tr>
<td>B. Free Reserves</td>
<td>21</td>
</tr>
<tr>
<td>C. Disaggregation and Liquidity</td>
<td>27</td>
</tr>
<tr>
<td>1. Seasonal Variation</td>
<td>31</td>
</tr>
<tr>
<td>D. Borrowings</td>
<td>35</td>
</tr>
<tr>
<td>1. Notation and Comments</td>
<td>45</td>
</tr>
<tr>
<td>2. Specification of the Borrowing Equation</td>
<td>48</td>
</tr>
<tr>
<td>E. Excess Reserves</td>
<td>57</td>
</tr>
<tr>
<td>F. Short Term Security Holdings</td>
<td>62</td>
</tr>
<tr>
<td>G. Supply of Commercial Loans</td>
<td>69</td>
</tr>
<tr>
<td>III. INTEREST RATES AND THE BEHAVIOR OF THE NONBANK SECTOR: THE BASIS FOR A DEMAND FOR MONEY</td>
<td>86</td>
</tr>
<tr>
<td>A. Demand for Commercial and Industrial Loans</td>
<td>86</td>
</tr>
<tr>
<td>B. Inventory Investment</td>
<td>96</td>
</tr>
<tr>
<td>C. Fixed Investment</td>
<td>107</td>
</tr>
<tr>
<td>D. Long Term Interest Rates</td>
<td>124</td>
</tr>
</tbody>
</table>
## LIST OF FIGURES

### CHAPTER II

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>Description</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>II.1</td>
<td>Free Reserve - Deposit Schedule, as a function of the bill rate.</td>
<td>26</td>
</tr>
<tr>
<td>II.2</td>
<td>Levels of Excess Reserves and Borrowings for Country and City Banks</td>
<td>32</td>
</tr>
<tr>
<td>II.3</td>
<td>Relative (to net demand deposits) Levels of Excess Reserves and Borrowings for Country and City Banks</td>
<td>33</td>
</tr>
</tbody>
</table>
A. INTRODUCTION

In what follows we shall be concerned with a detailed elucidation of the workings of the commercial banking system. There are several reasons for undertaking a relatively careful investigation of this sector of the economy. First, an examination of the portfolio behavior of the commercial banks is interesting in its own right as an example of economic decision making under a set of institutional constraints and various types of uncertainties. Second, decisions of the commercial banks have an important impact on the real part of the economy via their effects on the supply of funds and the structure of interest rates, and we shall have occasion to later examine this link. Finally, a study of commercial bank behavior with reference to that sector's role in the transmission of Federal Reserve policies is important for any study of the effects of monetary stabilization policies.

If the supply of money or the volume of demand deposits is the crucial quantity which the Federal Reserve wishes to influence, then we must examine the link between variables directly controlled by the Fed and the money stock. The traditional analytic tool for examining the connection between the actions of the central bank and the responses of the commercial banks has been the reserve-multiplier analysis
which relates changes in bank demand deposits to prior changes in the available supply of primary reserves via "the" legal reserve ratio. In applying this tool, economists have usually assumed that banks will fully utilize the available supply of reserves although some versions of this approach have allowed (conceptually at least) for some of the numerous possible leakages such as currency in circulation. The reserve-multiplier approach even in its less rigid forms leaves much to be desired as an explanatory link between the central bank and the banking system as a whole since it offers no elucidation of the behavior (and a fortiori of the logic behind such behavior) of the commercial bankers.

In what follows we hope to replace this approach with one offering some insight into the decision processes of commercial bankers. In particular, we shall demonstrate that the supply of money may be regarded as a consequence of the portfolio management of the commercial banks. We shall divide bank portfolios into several broad asset categories and pay particularly close attention to certain problems confronting bank managers in the allocation of funds to the liquidity and commercial loan components of their portfolios. In the empirical implementation of our study we shall disaggregate the data both with respect to individual liquid assets (e.g., excess reserves, borrowings, holdings of short term securities)

1 For a similar statement on the shortcomings of the reserve multiplier approach see [10,p.1]
and with respect to certain regional classifications of banks (e.g., country and noncountry banks). Following this examination of bank behavior, we shall turn to a limited investigation of certain nonbank sectors of the economy. In particular, we shall discuss the demand for commercial loans, the demand for inventory and fixed investment goods, and in a limited context the structure of interest rates. Having discussed each of these sectors and presented some sample single equation least squares estimates of the individual equations, we shall then formulate a closed simultaneous equations macroeconomic model of the postwar U.S. economy and proceed to estimate the entire model by two stage least squares. It should be emphasized that this is not merely another attempt to build a general U.S. econometric model, but rather an attempt to construct a minimally complete model which contains a detailed description of the banking sector and of the reactions of other sectors to the behavior of the banking sector. Consequently, in the model we shall present, those aspects of economy which are not directly related to the behavior of the banking sector are simplified as far as possible. We shall conclude this study with an analysis of the results and an indication of the directions in which a more complete investigation of this type might lead.
B. ILLUSTRATION OF APPROACH

By way of illustration of the approach we will utilize below, let us briefly consider a banking system which is similar to that of the U.S. in most ways but which is simplified in the following respects: every commercial bank is a member of the Federal Reserve System subject to a uniform reserve requirement $k$ on demand deposits and faced with a uniform discount rate $r_d$ and without time deposits. A simplified balance sheet of the banking system might appear as follows.

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities and capital accounts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total reserves</td>
<td>Deposits</td>
</tr>
<tr>
<td>Short term government securities</td>
<td>Borrowing</td>
</tr>
<tr>
<td>Other securities</td>
<td>Other Liabilities</td>
</tr>
<tr>
<td>Loans</td>
<td>Total liabilities</td>
</tr>
<tr>
<td>Other assets</td>
<td>Capital accounts</td>
</tr>
<tr>
<td></td>
<td>Total liabilities and</td>
</tr>
<tr>
<td></td>
<td>capital accounts</td>
</tr>
</tbody>
</table>

Letting total, required, unborrowed, and free reserves be noted by $R_T$, $R_R$, $R_U$, and $R_F$ respectively, and denoting excess reserves and borrowing by $E$ and $B$ respectively, we
can write the following definitional relations.

\[ \begin{align*}
RT - B &= RU \\
E - B &= RF \\
RT - R^F &= E \\
R^R &= k \cdot D
\end{align*} \]

where \( D \) is total deposits against which reserves must be held. We then have

\[ \begin{align*}
RU &= RT - B = R^R + E - B = R^R + RF \\
D &= R^R / k = (RU - RF) / k \\
k \cdot D + RF &= RU \\
D \left( k + \frac{RF}{D} \right) &= RU
\end{align*} \]

Equation (1) relates the level of demand deposits (and with one further assumption the supply of money) to the supply of unborrowed reserves, the reserve requirement and the free reserve-deposit ratio of the commercial banks. Any standard exposition of the workings of the Federal Reserve System enumerates, via the balance sheet approach, the factors with which the Federal Reserve must contend if it proposes to control the supply of primary reserves\(^1\). While there will certainly be forecasting errors which lead to short run deviations of primary reserves from the level the Fed desires, 

\(^1\) See, for example [7]
it is now widely accepted that over a reasonable time period "the supply of primary reserves is what the Federal Reserve wishes it to be." ¹ Thus in equation (1) the free reserve-deposit ratio is the only variable outside the control of the Fed, and hence monetary policy would be aided by relating this variable in some consistent and predictable way to a known set of economic variables².

Given the supply of unborrowed reserves, the reserve requirement, the discount rate, and a set of related institutional factors, we shall set forth below how we can view the level of free reserves as a result of the portfolio decisions of the commercial banks. Then through an equation similar to (1) we shall have a relationship expressing the level of demand deposits (and thence the supply of money) as a function of bank management decisions. We can illustrate briefly the idea behind the first part of this by noting that free reserves have long been identified as one measure of liquidity. In addition, the sum of free reserves and short term security holdings is also often cited as a bank liquidity measure³. For purposes of illustration let us posit the

---

¹ [56, Chap 9, p.8 ]
² The reader will observe that we have identified primary reserves with unborrowed reserves which is not strictly correct. However, the arguments generally made to demonstrate the short run control of primary reserves are only valid for unborrowed or supplied reserves since they ignore the borrowing aspects. For a similar point see [8,p.30].
³ See below, page 24.
somewhat more general liquidity measure given by

\[ P = a E + \beta B + \gamma S \]

where \( E \), \( B \), and \( S \) are the holdings of excess reserves, borrowing and short term securities respectively of the commercial banks, and \( a, \beta, \gamma \) are posited as unknown but fixed behavioral parameters. This is a more general case of the two liquidity measures mentioned above and as such removes some of the undesirable features of simply adding free and secondary (security holdings) reserves. It still, however, remains a highly aggregative measure and as such is to be used cautiously.

We can now posit that the relative (i.e., with respect to demand deposits) level of each of the three liquidity components is a certain fraction of total relative liquidity which is modified by certain economic considerations. We can schematically write this as

\[
\begin{align*}
\frac{E}{D} = a \frac{P}{D} + f(x) \\
\frac{B}{D} = b \frac{P}{D} + g(x) \\
\frac{S}{D} = c \frac{P}{D} + h(x)
\end{align*}
\]

where \( x \) is a vector, as yet unspecified, of variables which may differ in each equation. Substituting (2) into (3) and solving, we can write the resulting expressions:

\[
\frac{E}{D} = \left( \frac{a\beta}{1-\alpha a} \right) \frac{B}{D} + \left( \frac{a\gamma}{1-\alpha a} \right) \frac{S}{D} + \frac{1}{(1-\alpha a)} f(x)
\]
\[ B/D = \left( \frac{ba}{1-b\beta} \right) \frac{E}{D} + \left( \frac{b\gamma}{1-b\beta} \right) \frac{S}{D} + \left( \frac{1}{1-b\beta} \right) g(x) \]

\[ S/D = \left( \frac{ca}{1-c\gamma} \right) \frac{E}{D} + \left( \frac{c\delta}{1-c\gamma} \right) \frac{B}{D} + \left( \frac{1}{1-c\gamma} \right) h(x) \]

It is equations of this form which shall concern us below. Before, however, estimating this type of model we must examine in some detail the considerations which will aid us in the proper specification of the variables to appear in these equations. It is to this task that we now turn.

---

1 It should be noted that the six right hand coefficients of E/D, B/D and S/D are not independent. Thus in estimating equations of this form one should, strictly speaking, take the a priori restrictions into account. The restrictions in this case are not linear, and incorporation of these into a standard estimation procedure can, however, present many difficulties.
CHAPTER II

Bank Liquidity: The Basis for a Money Supply Formulation

We suggested in the previous chapter that the supply of money can be regarded as a product of certain bank liquidity decisions. This chapter shall investigate in some detail the nature of these decisions while Chapter IV shall integrate these results with a determination of the money supply. We begin with a brief discussion of liquidity and of the various sources of uncertainty facing a bank which create a need for liquidity. We then turn to an examination of one of the traditional bank liquidity measures, namely, the level of free reserves. Following this we demonstrate the inadequacy for empirical work, of an aggregate free reserve variable, and we advocate disaggregation in several directions. In particular, we formulate behavioral relationships explaining the holdings, by various classes of banks, of excess reserves and borrowings, and we present some single equation estimates of these results. Short term securities (i.e., secondary reserves) provide an additional source of bank liquidity, and for this reason we then examine bank holdings of these assets. Following the formulation of a behavioral relationship explaining these holdings we present some single equation estimates of this result. The chapter concludes with a dis-

1 In fact a result similar in spirit to equation (1) of the preceding chapter will be derived under more realistic assumptions. Through this we shall be able to calculate various elasticities of the money supply with respect to its determinants.
Discussion of the commercial loan market, which is of major import-
ance in creating a need for liquidity. In particular, we investi-
gate the supply of commercial loans and the deter-
mination of the bank loan rate.

A. LIQUIDITY AND UNCERTAINTY

Qualitatively speaking, the liquidity of a credit in-
strument refers to the property of being easily transferrable
between creditors. Among the numerous aspects inherent in the
liquidity concept are negotiability, reversibility, and mar-
ketability. Negotiability is a self-explanatory legal concept
and will not be discussed. Reversibility refers to the ability
of the asset (representing future sums) to be converted into
present sums in a short period of time and without appreciable
money loss. Marketability refers to the existence of a reg-
ular transactions market for a particular type of credit in-
strument and clearly influences the immediate cash value of
an asset.

In discussing the liquidity of a portfolio we can dis-
tinguish between liquidity and the need for liquidity. With
respect to this distinction one possibility is to define li-
quidity as 'moneyness' of the assets of the portfolio and to
regard the need for liquidity as a function of the liability
side (and other factors as well1). A second possibility is to

1 'Moneyness' must of course be made into a precise concept.
One might define portfolio liquidity in terms of a prob-
ability distribution of cash recoverable from the sale of
assets of a portfolio on short term notice and hence one
can give formal meaning to the cash equivalent of an asset.
For a discussion of this point and a related liquidity dis-
ussion see [30, pp. 16-17].
include the liability side of the portfolio in the liquidity concept, for example, by defining liquidity as the ratio between certain assets and certain liabilities. When we turn to the specification of our econometric model, this is in fact the procedure we shall follow. Let us now, however, address ourselves to the following question: what are the sources of uncertainty facing a bank and how do they create a need for liquidity?

There are a variety of sources of uncertainty facing a commercial bank. The general nature of the issue is suggested by a how-to-measure-liquidity-needs section of a recent examination of the commercial banking system. In particular the subheads of the section listed below are indicative of the general problem: what is the share of time deposits? how many deposit accounts does the bank have? who are the large depositors? how stable are their accounts? what other unstable accounts does the bank have? and is the bank retaining its proportionate share of the business in its trade area? Broadly speaking, we can distinguish three types of uncertainty. First, there is, as is indicated above, uncertainty with respect to the future level of deposit liabilities. Second, there is uncertainty with respect to the direction and magnitude of shifts in the current interest rate structure and hence with regard to the market value of the non-matured securities in the bank's portfolio. Third, there is a set of problems con-

1 See [2, pp. 275-7]
cerned with the proper evaluation of the loan component of the bank's portfolio.

There are several different types of deposit variability, and they may have different consequences for the bank. The first is variation in the aggregate level of deposits, maintaining the same relative distribution of deposits between banks. This, for example, might be caused by a cyclical decline in the aggregate demand for bank loans. The second is a systematic redistribution of demand deposits among banks with the total level of deposits remaining the same. This, for example, could reflect competitive pressures within a region or perhaps interregional shifts occasioned by firm relocation. Thirdly, there are random influences of a purely temporary nature. In practice, of course, banks experience two or more of these sources of variation at one time and may experience difficulty in separating out the transitory and permanent variability. For example, it is often argued that if a bank is "in step" with general expansion it can expect its share of deposit growth, but if it overexpands loans relative to the banking system, it can expect greater deposit variation. The difficulty, of course, in applying this rule is to determine the quantitative meaning of "in step".

In any event an unfavorable change in a bank's deposit liabilities can create a shortage of reserves, and in these circumstances it will have need of assets convertible to re-

---

1 See [49]
serves at its Federal Reserve Bank. A bank faced with this situation has several alternatives open to it. It can call outstanding loans, or it can borrow the necessary funds from its Federal Reserve Bank or in the Federal Funds market, or it can sell securities.

The first alternative, the calling of loans to meet short run variations in certain types of assets and liabilities, is in general not considered sound banking practice. In fact, as we shall see later, customer loan demand itself represents a source which provides a drain on a bank's liquid assets. For the present it will suffice to note the following from a standard text on the management of bank funds:

"Although there is no legal responsibility to make loans, any bank which wants to enjoy good profits, to perform its expected function in the community, and to attract customers must be prepared to meet all legitimate loan demands." 2

1 In discussing bank liquidity decisions the New York Federal Reserve Bank has noted:
"The source of funds to which a member bank turns when it finds itself in need of reserves will depend on the expected duration of the need for reserves, the availability of liquid short-term investment assets in portfolio, and the money management practices of the bank. Reserve shortages that are expected to be of some duration may be covered by liquidating Treasury bills or other secondary reserve assets, if there are available in sufficient amount in the bank's portfolio... When the reserve need is expected to be of only a few days or, at most a very few weeks duration, a member bank may properly borrow from its Federal Reserve Bank." [19, p. 138] 2

[49, p. 23]
The second alternative, that of borrowing from the discount window, depends on the willingness of the bank to take the initiative in the borrowing action and on the current status of the bank with its Federal Reserve Bank Discount Committee. This in turn depends on a set of factors to be dealt with extensively below, and hence for the present time we shall rule out the borrowing alternative\(^1\). Thus, the only alternative we are admitting for the present is the sale of securities\(^2\). Since the most significant part of the security component of the commercial bank portfolio is held in U.S. government securities, we shall restrict our attention to these.

The major source of product differentiation among these securities is their maturity. While it is generally true that a longer term security, if held to maturity, will yield more than a shorter one, it is also generally true that there is a greater degree of uncertainty associated with the price of a longer term security if sold before it matures. These offsetting factors suggest that there is in some sense an optimum between the two extremes of holding zero yield, perfectly liquid cash, and relatively high yielding long term securities. As a result of this economic tradeoff, which we

---

\(^1\) See page 35 below for a complete discussion of the discount window. For an examination of the role of the Federal Funds market see [6] and [62].

\(^2\) We are of course simplifying in that other assets might also qualify for inclusion in the liquidity portfolio. For example we might add short term loans to prime credit risks, banker's acceptances and call loans to security brokers and dealers.
will examine in greater detail below, commercial banks have tended to rely on short term U.S. securities (bills, certificates, notes and bonds nearing maturity) as the major source of their liquidity.

Short term governments provide a natural choice for secondary reserve or for bank liquidity in that they are assets of a highly predictable money value and that they exist in a wide homogeneous stock traded in a broad market. In addition, they are free from the risk of default and can be used at par to secure advances from the Federal Reserve Banks. There is no definite maturity separating short from long term, and bankers vary in their opinions on the matter. However, one year appears to be a widely accepted rule of thumb. In fact, the Federal Reserve in its monthly examination of bank liquidity, appearing in the Bulletin, sums free reserves and U.S. government securities within one year to obtain its measure of liquidity.

1. **Bank Loan Portfolios**

Let us now turn to the loan component of a bank's portfolio, with which there is also associated uncertainty and a consequent need for liquidity. Survey studies at various times have established that business firms who borrow from commercial banks tend to be of less than average profitability and also tend to be repeat customers.¹ In addition, these

¹ [49, p. 96]
firms are often in the initial phase of establishment. These characteristics point up two sources of uncertainty with respect to the loan portfolio. Namely, the proportion of borrowers who will default and, as Porter has phrased it, the extent of "frozenness" of the loan portfolio. The latter refers to the percentage of renewal requests which may precede a loan's maturation. They are an indication of the fact that the nominal maturity distribution of a loan portfolio may have very little to do with the actual liquidity of the portfolio. For the same reasons that a bank will cater to its customer loan demand at the initiation of a loan, it will presumably be motivated to renew the loan. However, in the case of renewals something in addition to customer goodwill may be at stake. That is, the borrower may be unable to repay the loan and the bank is consequently faced with the alternatives of renewal or default. Thus, the degree of frozenness depends both on the willingness and the ability of the customers to accept the refusal of loan renewals.

A third source of uncertainty is connected with the future level of new loan demand. One author has written "...the greatest source of liquidity to meet new credit requests should, of course come from the loan portfolio itself, through the turnover of loans."2

1 [47]
2 [34, p. 16]
However, he then goes on to admit that this rule may not be helpful in the face of pronounced seasonal variation for loans. In addition, he allows the need for additional liquidity if a bank is experiencing an overall growth in loans. Thus, in fact, the above "principle" may offer very little solace for a bank concerned with providing for its customer loan demand. The bank will presumably be forced to make a set of forecasts in connection with its loan demand and in general will have to provide for a certain amount of loan liquidity. We shall have occasion to estimate below the effect of loan demands on liquidity holdings and shall return to this point at that time.

There are practical limitations to a bank's ability to lend. The liquidity need, which all sound bankers are supposed to put before income considerations, is one constraint to bank lending activity. In addition, borrower characteristics are such that loans provide the riskiest component of an investment portfolio, and diversification of risk considerations will eventually suggest a curtailment of loan activity. A third limit to loan expansion is that increasing loans serves to increase the chance of failing to meet the reserve test. This fact can be demonstrated simply, as follows.

From our simplified balance sheet appearing in the preceding chapter we have the following relationship
Deposits + Borrowing + Other Liabilities + Capital Accounts

= Total Reserves + Loans + Investments

or

\[ D + B + OL + CA = R_T + L + I \]

Substituting the identities we had earlier, namely \( R_T = R^R + E \), \( R^R = k \cdot D \) we have

\[ (1-k)D + B + OL + CA - L - I = E \]

The volume of deposits can, of course, be controlled to some extent from within by an individual bank. In part, \( D \) depends on the overall asset structure of the bank. In particular, when a bank makes a loan to a customer, it simply credits his account, and hence \( D \) depends on the volume of loans.

The extent to which a bank can expect to retain loan created deposits depends on several factors including its size and location. Let \( D_L = \rho(L) \), known as the deposit retention curve, represent the deposit level corresponding to a given volume of loans. Since a bank will retain some fraction of its loan created deposits, we have that \( 0 < \rho'(L) < 1 \). Let us now introduce uncertainty into the example. Tobin has noted:

"The consequence of deposit withdrawals, against which the bank protects itself by excess reserves, is not the disaster of insolvency but the additional cost, including perhaps inconvenience and damage to prestige, involved in meeting the reserve test. Given these costs, uncertainty about the future level of deposits will lead to a lower volume of lending and a higher volume of reserves than (the) profit maximization."

\[ [56, \text{ Chap. 9, p. 16}] \]
Of course, the presence of uncertainty means that for each \( L \) we have a probability distribution of \( D_L \). To include this case, we write \( D_L = \rho(L) + x \) where \( x \) is a random variable with mean zero. There may in fact be additional influences which will tend to increase or decrease deposits over time but which are not related to asset holdings. Let \( B \) represent the effects on the expected level of deposits of nonrandom influences other than \( L \). Then we can write deposits as

\[
B + \rho(L) + x
\]

Substituting into our balance sheet identity yields

\[
E = (1-k)[B+\rho(L)+x] + OL + CA - L - I
\]

where we view everything but \( L \) and \( E \) as given. Now the probability of \( E \) being less than zero is equal to the probability of \( x \) being less than \( Z \) or more precisely

\[
Pr(E<0) = Pr(x<Z) = F(Z)
\]

where \( F \) is the cumulative distribution of \( x \) and \( Z \) is given by

\[
Z = -[B + \rho(L)] + \frac{L+I-OL-CA}{1-k}
\]

If \( x > Z \) the bank has positive excess reserves and if \( x < Z \) the bank has a negative net reserve position. We have

\[
\frac{\partial Z}{\partial L} = \frac{1}{1-k} - \rho'(L)
\]

but since \( 0 < k < 1 \) and \( 0 \leq \rho'(L) \leq 1 \) we have that

\[
\frac{\partial Z}{\partial L} > 0.
\]
Thus as a bank expands loans, the increase in leakage of loan created deposits raises the probability of having a negative reserve position. As Tobin has expressed it:

"Every increase in loans thus increases the probability that the bank will be subject to the special costs of meeting a negative reserve position. If the costs of lending are reckoned as the expected costs of providing the funds, the expected special costs must be included. They contribute to the marginal as well as to total expected costs. Indeed, if the probability distribution has the general...S-shaped cumulative..., marginal expected costs will normally increase with the volume of lending."¹

One qualification to this suggestive exercise is in order. Namely, we made the deposit retention curve ρ depend only on L. In actuality ρ may depend on other factors such as age distribution of loans. Loan accounts are probably relatively active ones. In particular, it is possible that new loans are more likely to be an active drain on deposits. Also loans maturing, depending on their frozenness, may or may not be repaid. Thus, whatever factors influence frozenness may also influence deposit retention.

Our above discussion has indicated some of the sources of uncertainty necessitating a provision for liquidity and has indicated briefly some aspects of the banking system's solution to this problem. In addition, we have noted the widespread use of the level of free reserves as an indicator of bank liquidity. The use of this measure suggests that a careful examination of free reserves may help in providing an

¹ [56, Chap. 9, pp. 18-19]
empirically useable model of bank liquidity determination. With this in mind let us now turn to a discussion of free reserves.¹

B. FREE RESERVES

As Tobin has noted, a widespread and generally implicit assumption is that the equilibrium demand for free reserves on the part of the banks is constant (generally zero) over time.² This assumption manifests itself in many expositions of the banking system and the monetary mechanism. We do not mean to imply that this assumption is a universal one. Ralph Young, for example in an essay states:

"a Federal Reserve decision to limit the volume of member bank reserves is, in a sense, a decision to put member banks as a group under pressure to borrow reserve funds. A higher level of member bank borrowings, representing increasing frequency, amount, and duration of dis- countings by a growing number of banks, is a normal and expected reaction to a restrictive monetary policy."³

¹ It should be noted that the liquidity position of a bank is in many ways analogous to the transactions balances of an individual. It is well established that the inventory theoretic approach yields fruitful results in the latter instance (e.g., see the demand for money discussion appearing below), and hence it is not surprising to find various writers discussing bank liquidity in terminology appropriate to an inventory framework. For example, Porter, [47], has observed "Cash and other assets readily convertible into cash represent 'inventories', the carrying cost of these 'inventories' is the surrender of earning power and various penalties are incurred for insufficient 'inventories'." A similar observation has been applied, in a very limited context by Orr and Mellon, [44].

² See [56, chapter 9].

³ [63, p. 34].
In addition, Meigs devotes a section to an interesting historical development of this point. In what follows we shall replace the simple assumption of a constant demand for free reserves with a more realistic theory which recognizes that this demand results from an economic calculation, dependent, in part, on costs and opportunities at the discount window, in the money market and in commercial lending operations of the banks. We shall first present a brief outline of Tobin's exposition as found in his unpublished monetary manuscript. We shall then proceed to expand and modify this exposition in the light of U.S. banking experience, and we shall then embed the model in a framework suitable for empirical investigation.

According to Tobin

"if the Federal Reserve maintains the discount rate unchanged, there is a tendency for net free reserves to rise by some fraction of a dollar whenever the Federal Reserve augments the supply of primary reserves by one dollar."

The mechanism by which this occurs can be described as follows. If we start from an equilibrium level of free reserves, then Federal Reserve open market purchases (conducted in bills, say) will raise \( R^F \) above its former equilibrium level. These open market operations lower the bill rate and decrease the incentive of the banks to economize cash and to borrow from the Fed and consequently raise the equilibrium level of free reserves.

1 [37, Chap. II]
2 [56, Chap. 9, p. 18a,b]
serves. It should be noted that the banks in attempting to reduce their free reserve position will further depress the bill rate if they do so by purchasing short term securities.

Under the hypothesis which keeps $R^F$ constant, a dollar change in the supply of reserves is necessary and sufficient to cause an equal change in the volume of required reserves. A result of the approach used above, however, is a loosening of the causal link between the volume of bank assets and deposits and the reserve base. Thus banks may change their equilibrium level of $R^F$ even if the supply of primary reserves remains constant. This can result from one or more of the following consequences: (1) the discount rate may change; (2) the banks' cash preferences and expectations of future economic magnitudes may change; and (3) the various money market rates may change as a result of the asset choices of the non-bank public.

As an examination of U.S. banking data will reveal, the variability of the banking system's demand for $R^F$ is more than a theoretical possibility. For example, $R^F$ varied from -5% to 5% of required reserves during 1951-59. In addition Tobin has calculated that

"the standard deviation of the weekly change in net free reserves was 258 million dollars, while the standard deviation of the weekly change in the supply of primary reserves was 366 million dollars. Their correlation was .56, indicating that changes in one component of required reserves tended to offset changes in the other."  

1 [56, Chap. 9, p. 18]
Thus it is clear that there is a good deal of erroneous simplification occurring when one uses the arithmetic of control of the supply of reserve funds to determine the volume of deposits.

Let us now turn directly to a brief presentation of Tobin's formulation of the determination of the equilibrium level of free reserves. Let us define the defensive position $P^*$ of a bank or a set of banks as the sum of its (their) free and secondary reserves. Tobin's solution, in terms of this construct, is a sequential one in which he considers two questions: (1) what determines $P^*$? (2) given $P^*$, what determines its division into its two components? The magnitude of $P^*$ is simply taken to depend on the differential between the loan rate and the Treasury bill rate, $r_l - r_s$. This differential is the opportunity cost of maintaining the defensive position since a bank could earn $r_l$ by investing a dollar of $P^*$ in loans but would sacrifice $r_s$ dollars in doing so. With regard to the determination of $R^F/P^*$, Tobin has noted that

"Other things equal, banks will wish to hold a larger share in secondary reserves the higher the rate of return they can earn on these assets, i.e., the higher the Treasury bill rate, and the lower the rate on net free reserves, represented by the Federal Reserve discount rate." 

---

1 With respect to the use of aggregate measures it should be noted that the Fed has stated, "Appraisal of bank liquidity must take into account not only aggregate measures but also shifts in the composition of bank liabilities and assets." For example, the recent greater importance of time deposits of "businesses and large individual investors in the growth of total time and savings deposits increases the potential volatility of such deposits." [21, July 1962, p. 795]

2 [56, Chap. 9, p. 22]
With a fixed discount rate OD, the diagram below represents the variation of the average cash reserve position as a function of the bill rate. When \( r_s \) is high relative to \( r_d \), a bank short of reserves will be motivated to borrow rather than sell bills and to buy bills rather than repay indebtedness if it has a temporary surplus. There is, of course, an essential difference between \( R^F < 0 \) and \( R^F > 0 \). A bank earns nothing on excess reserves but can earn \( r_d \) on temporary surplus funds by repaying debt. Thus for \( r_s \) in the neighborhood of \( r_d \), a bank might reduce debt rather than purchase bills but would buy bills rather than increase idle excess reserves. The lower \( r_s \) is relative to \( r_d \), the less frequent will be the use of the discount window, although even with \( r_s < r_d \), banks may prefer on occasion to borrow rather than sell bills to meet a reserve shortage (e.g., if \( r_s \) is expected to fall). However, if \( r_d \) is well above zero and \( r_s \) sufficiently below \( r_d \) to discourage borrowing, \( r_s \) can still be high enough to encourage cash economy. Thus, a high bill rate would yield an incentive to let fluctuations in deposits and loans be reflected in a varying free reserve position. On balance, as the diagram below demonstrates, a bank's cash demand is composed of two components. When there is no incentive to borrow, cash demand depends simply on \( r_s \), but when the borrowing incentive is present, it de-
FIGURE II.1

-1.00 free reserves
defensive position

-1.00 defensive position

0. bill holdings
defensive position

1.00 bill rate

2.00
pends on \( r_s \) relative to \( r_d \).

We thus see that Tobin's free reserve formulation makes explicit the nature of some of the economic calculations made by a bank in determining the composition of its portfolio. It is a highly suggestive analysis, and in what follows we shall present a modified version of this analysis which shall yield equations suitable for inclusion in our econometric model. With this in mind let us turn to a discussion of several possible modifications of the free reserve analysis presented above.

C. DISAGGREGATION AND LIQUIDITY

It is one of the contentions of this thesis that the aggregate level of free reserves is not an appropriate behavioral variable with which to work in an empirical study of the postwar U.S. economy. In particular, we advocate disaggregation in two directions. The first is a separation of the free reserve variable into its two components, excess

---

1 It should be noted that the borrowing behavior implied by the above is quite consistent with the Federal Reserve discount window policy. For a full discussion of this point see D. below. Tobin also performs a similar analysis after explicitly recognizing the existence of the Federal Funds market. The conclusions, however, remain unchanged. The only effect of that market is to shift the banks aggregate cash preference curve to the left. This, of course, has operational significance for monetary policy, but if a new preference curve can be determined, will not necessarily reduce the effectiveness of monetary policy. See, [56, Chap. 9, pp. 30-4]
reserves and borrowings, and the second is the disaggregation of the basic banking data into a country and city classification. We shall discuss each in turn.

There are several reasons for advocating separation of free reserves into its two components. First, there can simultaneously be significant levels of both excess reserves and borrowings. That this is true reflects the fact that the tradition against borrowing falls quite unevenly on individual bank management philosophy. Thus, while certain banks never borrow, others make extensive use of their discount privilege. Hence, the movement of free reserves reflects, to some extent, the aggregation of the decisions of bankers solving their liquidity problems in different ways, and it is desirable to separate out these effects. Secondly, there are certain factors which can a priori be expected to influence excess reserves and not borrowings (or vice versa), and these effects can be obscured by aggregation. Thus, for example, the Tobin free reserve formulation presented above found that a bank's cash demand schedule had two components depending on whether or not there was an incentive to borrow. Finally, there is no reason to presume that bankers regard excess reserves and borrowings as strictly additive forms of liquidity. For example, the tradition against borrowing may cause certain bankers to weight borrowings more heavily negative than is done in the free reserve measure (i.e., less than the implicit weight of -1). There thus appears to be sufficient reason for
disaggregation in this first direction.

The second direction of disaggregation is suggested by the fact that there appear to exist on the U.S. banking scene significant behavioral differences among various banking units with respect to their liquidity portfolio management. Other writers have observed this same point although it has rarely, if ever, been incorporated into any monetary econometrics. For example, one of the Federal Reserve Banks has noted

"The unique characteristic of large banks compared with smaller institutions is that while the day to day fluctuations are relatively small in percentage terms, the amount is large enough to justify special action to gain earnings on these transitory balances."1

With respect to the same issue Tobin has observed:

"Active reserve management earns interest, at the cost of numerous money market and discount window transactions. Differences among banks and bankers in circumstance and temperament are to be expected; the costs of active reserve management loom much larger for small country banks than for big New York or Chicago banks."2

Individual banking data is unavailable, and even if it were available, it would be neither tractable nor appropriate for our macroeconomic intentions. A more satisfactory classificatory scheme, and one which is readily available from the Federal Reserve separates member banks into three categories:

1. [20, p. 1]
2. [56, Chap. 9, p. 23]
central reserve city (New York and Chicago available separately); reserve city; and country. In what follows, however, we shall restrict our attention to the twofold classification, country and non-country (which we shall simply call city). ¹

The effect of aggregating country and city sectors can be seen, for example, by examining the time profile of free reserves for the sectors individually and for the total banking system. Since 1947 free reserves for all banks have been negative for a total of eighteen quarters. However, in that same period the city banks have had a negative position thirty-two times while the country banks have never had a negative free reserve position. In fact, except for four quarters (all over 100 million), the country banks have had free reserves of over 200 million and generally a good deal more.

The basic data appear even more heterogeneous if one examines the components of free reserves separately. Let us denote by \( B^N \), \( E^N \), \( D^N \) and \( B^C \), \( E^C \), \( D^C \) the levels of city and

¹ There are several reasons for this. For one, an examination similar to the one below of the basic bank data revealed that the city category is a relatively homogeneous one. Secondly, practical limitations to the size of the model provided limits to the extent of disaggregation.
country borrowing, excess reserves, and net demand deposits respectively. The graphs below present a postwar comparison for borrowing and excess reserves by sector.

As is immediately evident there is a pronounced difference in the levels of excess reserves and borrowings which these two categories of banks have held in the postwar period. While there appears to be a secularly increasing trend in the ratio $D_C/D_N$, the average value for the period is approximately one-half. Thus, the differences with respect to excess reserves and borrowing are even more pronounced if one takes into account the fact that country banks have a smaller share of the deposits. This can be seen below where we have graphed $E_N/D_N$, $E_C/D_C$, $B_N/D_N$, $B_C/D_C$.

A final factor which also points towards the disaggregation of the banking data into country and city classes is the fact that these two types of banks are likely to experience a different seasonal pattern in the demand for funds and hence are likely to have seasonally different liquidity needs. We conclude this section with a discussion of seasonal variation.

1. **Seasonal Variation**

The general overall pattern of business activity is for a relatively mild first two quarters (except for Easter) with a gradual increase in the third quarter and a pronounced seasonal peak in the fourth quarter (around Thanksgiving-
FIGURE II.3

Key: (Top)  
- \( \frac{B^C}{D^C} \)  
- \( \frac{B^N}{D^N} \)  
- \( \frac{E^N}{D^N} \)  
- \( \frac{B^C}{D^C} \)
Christmas). This type of seasonal pattern will presumably influence the reserve position of banks in several ways. To the extent that it affects banks via an increase in the use of the check payment mechanism, it means that banks in all locations will be subject to an increased probability of having adverse clearing balances (ceteris paribus). It will also affect banks through a seasonal expansion of loans, both consumer and business, which will further put banks in a less liquid position.

These types of seasonal activity will presumably have a greater influence on the reserve positions of banks located in industrial centers, and thus we should expect a corresponding seasonal pattern to manifest itself in the liquidity portfolio of our noncountry bank classification. However, commercial banks located in principally agricultural areas, resort areas, or regions in which a single type of business predominates will not only be subject to large seasonal variations (relative to their deposit liabilities) but also may find themselves facing a seasonal pattern different from the one noted above. A bank located in an agricultural area (presumably a country bank by our classification) will find that its customers receive most of their cash income in the fall (harvest time), and consequently its deposits will rise significantly at that time. However, in the spring when the time comes to plant and cultivate crops, the bank will have to furnish credit to cover the purchase of seed, fertilizer,
labor and other costs and in fact will simultaneously find its deposits reaching a seasonal trough.

In general, the Fed has emphasized that a bank should prepare for predictable seasonal shifts through its cash or short term investment position. However, one former Federal Reserve official has noted:

"the bank may be faced with a seasonal problem substantially greater than that faced by most banks, so that it would be unreasonable to expect the bank to meet its entire seasonal needs from its own resources, even if it were able to predict the extent of those needs."1

Within a given seasonal cycle individual banks will find themselves short of reserves on different dates. Thus, we can expect that the entire seasonal pattern will be reflected in aggregate data.

Having presented a general discussion of the nature of the liquidity problem, we shall now turn to a more specific examination of several components of banks' portfolio. In particular, the remaining four parts of this chapter shall be devoted to a discussion of borrowing, excess reserves, short term security holdings, and the supply of commercial loans respectively.

D. BORROWINGS

Broadly speaking, there have been two views concerning member bank borrowing which can be termed the need and profit

1 [36, p. 98]
theories, respectively. The need theory states that member banks borrow merely to meet adverse clearing balances and temporary loan demands of their customers, and that they will repay these debts as quickly as possible. This theory is consistent with the tradition against borrowing discussed below, and many individual banks appear to behave in a manner consonant with this theory. However, serious doubts can be raised against the strength and extensiveness of the tradition against borrowing. The profit theory of borrowing emphasizes the securing of funds at one rate (the discount rate) and utilizing the funds in another market, thereby securing a higher rate of return for the bank. However, the considerable historical differentials that have existed between the discount rate and open market money rates attest to the fact that private banks are not motivated exclusively by profit considerations and do in fact exhibit a reluctance to borrow. Chairman Martin has mentioned both factors and he notes:

"In the first instance, increasing pressure on bank reserve positions (increased need for borrowing) may be developed through use of the open market instrument alone. At a point, however, it will become appropriate to support the effectiveness of this open market action by an increase in the discount rate, strengthening the reluctance of the member banks to remain indebted to the Federal Reserve by making borrowing more expensive as a means of adjusting bank reserve positions".¹

Various examples of both need and profit borrowing will be discussed below, and in the specification of our system we shall incorporate both of these hypotheses. However, we now

¹ Cited in [46, p. 3]
turn to a discussion of the tradition against borrowing.

The tradition against borrowing is deeply rooted in the historical development of American banking. In the nineteenth century borrowing under anything but extreme conditions was considered to be an overextension of the bank's asset position. One consequence of the commercial loan theory which prevailed until the early 1930's was that discounts were available only upon the presentation of "eligible" (self-liquidating, short term) paper. With the advent of the Depression many banks had exhausted their supply of eligible collateral and thus were unable to borrow from the Fed. As a consequence, many banks were forced to close down for lack of liquidity even though they had perfectly sound assets on their books. By 1934 the tradition against borrowing could almost be called a phobia. Use of the discount mechanism virtually ceased and was not reestablished until the early postwar years. The real resurgence of the discount mechanism took place following the Treasury-Federal Reserve accord in the spring of 1951. Borrowings accelerated rapidly, and the Federal Reserve felt a strong need to buttress the apparently weakened tradition against borrowing.¹ Chairman Martin in commenting on the period has noted:

¹ The increased borrowings of the period can to a large extent be attributed to the provisions of the excess profits law then in effect which made it profitable for member banks in excess profits tax brackets to borrow to increase their tax base. See page 41 below.
"Through a lapse of time some member banks had lost familiarity with the principles of law and regulation relating to the appropriate occasions for borrowing at the Reserve banks."

As a result of this apparent loss of reluctance to borrow from the Fed, Reserve officials undertook a campaign of re-education of the banker, which included both extensive speech making and correspondence. The Federal Reserve also began a comprehensive study of its discount function, and this was culminated in February, 1955, with the release of a major revision of Regulation A, the preamble to which is reproduced below.

Federal Reserve credit is generally extended on a short term basis to a member bank in order to enable it to adjust its asset position when necessary because of developments such as a sudden withdrawal of deposits or seasonal requirements for credit beyond those which can reasonably be met by use of the bank's own resources. Federal Reserve credit is also available for longer periods when necessary in order to assist member banks in meeting unusual situations, such as may result from national, regional, or local difficulties or from exceptional circumstances involving only particular member banks. Under ordinary conditions, the continuous use of Federal Reserve credit by a member bank over a considerable period of time is not regarded as appropriate.

In considering a request for credit accommodation, each Federal Reserve Bank gives due regard to the purpose of the credit and to its probable effect on the maintenance of sound credit conditions, both as to the individual institution and the economy generally. It keeps informed of and takes into account the general character of the loans and investments of the member bank. It considers whether the bank is borrowing principally for the purpose of obtaining a tax advantage or profiting from rate differentials and whether the bank is extending an undue amount of credit for the speculative carrying of or trading in securities, real estate, or commodities, or otherwise.

---

1 Cited in [36, p. 22]
The preamble presented above gives a partial listing of both the appropriate and the inappropriate uses of the discount facility. We shall now turn to a somewhat more detailed elucidation of these uses, commencing with the appropriate ones.

The most important general circumstance which leads to the use of the discount privilege is an unanticipated loss of reserves through the clearings process. A bank facing this type of reserve loss will be accommodated quite routinely at the discount window but will be expected to adjust its asset structure in an orderly fashion and to repay the temporary borrowings promptly. Another relatively frequent occasion for borrowing is an unexpectedly large seasonal loss of reserves. The unevenness of individual member bank seasonal requirements means that it is difficult to meet the seasonal requirements of the banking system as a whole by open market operations. The Fed has emphasized that a bank should not expect to borrow from its Federal Reserve Bank until the seasonal cycle has run its course. Here again they state that borrowing is a temporary expedient to aid in portfolio rearrangement. Borrowing under certain circumstances may also, as noted above, be appropriate for longer periods but these occasions are considerably less frequent. A bank, for example, located in a community that has been depressed for some time, may have a chronic shortage of reserves. Long term borrowing in this context in effect permits the Fed to pursue a regionally selective
monetary policy, perhaps diametrically opposed to its national policies.

With respect to inappropriate borrowing there are several different types of unwarranted use of the discount facility which vary in the degree of detectability. Thus, for example, a bank tending to borrow from its Reserve Bank during one or more reserve computation periods each month, at the point in the month when total reserves are lowest, would be "systematically" underestimating reserve losses. This, in the eyes of the Fed, would be relying on the discount window to supply part of a predictable need for reserves and is inappropriate regardless of how meritorious the loans made by the member bank may be. This type of behavior, if pursued by a member bank over a relatively long time period, would presumably be detected by the Fed. In general, however, the matter is not so simple. The Fed has stated that it attempts to establish "whether the need has, so to speak, been created artificially." However, as a former Federal Reserve official has observed, "...It is extremely difficult to pinpoint why a bank is borrowing." Other Federal Reserve officials have also indicated skepticism with respect to the success of policing inappropriate borrowing. For example, Charles Walker of the Federal Reserve Bank of Dallas has stated:

1 [19, p. 142]
2 [36, p. 116]
"If such policing is effective - and it is an administrative task of considerable proportions during periods of active discounting - there may be some discouragement of the speculative growth of credit. Too much should not be expected of this route, however, partly because of the administrative difficulties involved, and partly because control, even if effective, can be exercised only over the initial use of the funds." 1

With respect to borrowing to earn a rate differential, it is sufficient to note the following statement.

"On the other hand, if a bank borrowed temporarily to meet a commitment to make a loan to a business concern at 4 per cent, with reasonable expectations of having funds at hand shortly to pay out, the bank would not be borrowing to earn a rate differential even though it was borrowing at a lower rate (in one market) and re-lending at a higher rate (in another market)." 2

This pronouncement coupled with the already established difficulty in determining the purpose in borrowing indicates that there is sufficient room (certainly for short periods of time) to take advantage of favorable rate differentials.

Borrowing to gain a tax advantage has not been a problem since the removal of the excess profits tax established during the Korean conflict. A provision of that tax was to allow a proportion (75%) of average borrowing to be counted as capital in computing the rate of return, and this proportionally decreased the amount of earnings subject to the excess profits tax. In effect a bank could borrow at the then prevailing discount rate of 1.75% and could earn approximately 1% net after tax gain even if it allowed the proceeds of the

1 [59, p. 232]
2 [36, p. 106]
loan to lie idle. As a result of this provision, member bank borrowings attained extremely high levels in 1952 and 1953 and in fact in December, 1952, attained a level that has not been equalled since. This episode offers additional evidence that member bank borrowing is responsive to changes in the spread between yields on earning assets and the cost of borrowed funds. The 1952-3 experience was one of the major factors which led to the "reeducation" program noted above. Despite the occasion for abuse of the discount facility (or perhaps because of the difficulty of detection) Reserve Banks apparently do not often find it necessary to suggest to a bank that it is borrowing inappropriately. What appears to be relevant is the highly subjective notion of the "intent of the borrower". The New York Fed's definitive statement on borrowing has stated:

"So long as the member bank is making every reasonable effort to operate its business with its own resources, arrangements for temporary accommodation at the discount window can always be worked out." 1

If, however, a reprimand for inappropriate borrowing is deemed justified, it generally takes the form of a contact between a member of the Reserve Bank Discount Committee and a bank official. The objective, politely phrased, is to make sure the banker understands the philosophy behind the borrowing.

1 [19, p. 142] Bankers are reputed to dislike intensely being reprimanded for requesting inappropriate loans as it comes uncomfortably close to complete role reversal.
discount mechanism. Somewhat more grim is Roosa's comment that we help a bank decide not to borrow from us. This discouragement is extremely effective in limiting borrowing. McKinney, having examined Discount Committee records of the Fifth Federal Reserve District (Richmond), has noted:

"In practice, one a banker has been contacted, it is rare for him not to take the action necessary to limit his borrowings to appropriate uses of Federal Reserve credit." 1

Another feature which has tended to reinforce the tradition against borrowing is the common impression fostered by various writings (both official and unofficial) on the discount mechanism that the member banks are in practice subject to a refusal of a request for loans. For example, the Board's educational handbook describing the Federal Reserve System notes:

"When a member bank applies for accommodation, the Federal Reserve Bank is under no automatic obligation to grant the loan." 2

The truth is that while the Reserve Banks could by statute refuse to make loans requested by member banks, they in fact never do. Thus, one Federal Reserve official has declared:

---

1 [36, 114]
2 [7, p. 33]
"Even if it is felt that the bank is abusing the discount privilege, it has been the practice to make the extension of credit in order not to place the bank in an embarrassing position, and then to call on the bank and ask the management to restrict its borrowing activities to appropriate purposes in the future." ¹

In the absence of prior warning by Reserve officials, member banks can assume that their requests for loans will be granted although there is, of course, the possibility that this may lead to the "discouragement" of future requests.

Before concluding this section, we should note that the tradition against borrowing as felt by individual banks and the borrowing habits of banks are to a great extent both matters of management policy and philosophy. Over a period of time the evidence is that borrowing is largely done by the same group of banks. Some banks, in fact, never borrow, and for them the tradition remains law. Among the borrowing banks there is an entire spectrum of intensity of use which shifts up as borrowing needs and profitable opportunities present themselves. Of the 467 Fifth District member banks in existence in 1957, 224 had not borrowed from the Federal Reserve Bank in the past 21 years. Of those actually borrowing, the volume and period of borrowing varied significantly. There also appears to be an extremely wide divergence in attitude between country and city banks in this district, which further supports our claim on the need for separation of these two categories. Thus, for example, in the Fifth District in 1957,

¹ [36, p. 113]
88% of reserve city banks borrowed at least once, while only 28% of country banks did the same.¹ This concludes our general discussion of borrowing but before proceeding to the specification of our borrowing equations, it will be useful at this point to set out the notation we shall need for the remaining liquidity discussions, as well as some general comments on our single equation estimates.

1. Notation and Comments:

All time subscripts will refer to quarterly values and the absence of a subscript shall indicate the current value of the variable. We shall also make use of the superscripts N and C to differentiate noncountry (city) and country banks. The variables we shall use are as follows:

- \( E^N \): Excess reserves at noncountry member banks.
- \( B^N \): Borrowings at noncountry member banks.
- \( S^N \): Holdings of short term U.S. government securities at noncountry member banks.
- \( O^N \): Holdings of long term U.S. government securities at noncountry member banks.
- \( D^N \): Net demand deposits at noncountry member banks.
- \( E^C \): Excess reserves at country member banks.
- \( B^C \): Borrowings at country member banks.
- \( S^C \): Short term U.S. government securities held at country member banks.

¹ [36, Chap. IV] for data on the Fifth District.
$O_C^C$: Long term U.S. government securities held at country member banks.

$D_C^C$: Net demand deposits at country member banks.

$r_d$: Federal Reserve discount rate.

$r_s$: Yield on short term Treasury bills.

$r_e$: Rate charged on commercial and industrial loans.

$D^*: $ Potential deposits of the banking system given by

$$(1) \quad D^* = \bar{a} \frac{R}{k'd + k''(1-d)}$$

where

$\bar{a}$: Average ratio of total to member bank deposits.

$R$: Member bank total reserves.

$k'$: Average reserve requirement against demand deposits.

$k''$: Average reserve requirement against time deposits.

$d$: Ratio of demand to total deposits of member banks.

Data upon which both single equation estimates and the structural estimates discussed later are based can be found in the Appendix, together with comments on measurement, sources, and methods of derivation. The data used are quarterly time series beginning in the second quarter of 1950 and ending in the second quarter of 1962, thus providing a total of 48 observations. One of the contentions of this study is that the monetary and related sectors must be represented by a structural model. Given this, one has to justify preliminary
single equation least squares pilot investigations. If these investigations are used to make decisions with respect to inclusion of certain variables, functional form, or lag pattern (and they invariably are), then we are defeating to some extent the virtue of simultaneous equation techniques. Single equation estimates are, of course, eminently sensible from a practical point of view and this is in fact their only virtue. In what follows we have avoided making any close decisions on the basis of single equation estimates although certain grossly unsatisfactory forms were discarded on the basis of single equation estimates. Implicit in this procedure was the belief that the structural estimates obtained by use of two stage least squares would not lead to any new decisions in certain clear cut cases. A comparison of the single equation and structural estimates supported this contention.

There is a second consequence of our contention that the monetary sector must be represented by a structural model. In particular, only asymptotic properties of the structural estimates are known. Thus, strictly speaking, statistical tests which can be used where single equation models are appropriate do not apply to structural estimates or to these

---

1 This is not to say that another structural estimation technique such as full information maximum likelihood might not produce significantly large changes in the parameter estimates. The fact that it does so, however, also reflects its greater sensitivity to specification error.
exploratory single equation estimates. However, because of the need to establish a systematic method of evaluating the results, we shall, with serious reservations, tentatively use some of the usual regression criteria for this purpose. The inadequacy of these tests means, however, that one should place a relatively larger degree of reliance on the a priori specification of the model. With these qualifications in mind we can now begin with the specification of our first equation, namely the borrowing equation.

2. Specification of the Borrowing Equation

Our above discussion suggested that in measuring liquidity one alternative was to view the decision variable not as the level of liquid assets itself but rather the level considered relative to certain liabilities, thus incorporating the need for liquidity along with the assets comprising the liquidity. We shall in the formulation of the equilibrium determination of each of our three liquid assets (i.e., excess reserves, borrowings, and short term securities) follow this alternative. In particular, we posit that the relevant variables for investigation are $B^N/D^N$ and $B^C/D^C$, the ratios of borrowing to net demand deposits of noncountry and country banks, respectively. Net demand deposits were chosen as the appropriate liability since they represent deposits against which reserves must be held, and this is a
major reason for the need of liquidity.

The general discussion outlined above is suggestive as to the selection of explanatory variables. However, as with most literary expositions, it leaves much latitude in the exact choice of variables and the precise functional form of the equation. The first variable we shall consider is some measure of the relative cost upon which the choice between discounting and the liquidation of an asset depends. The demand for funds to satisfy the needs that typically induce banks to resort to the Federal Reserve discount facility is probably relatively insensitive to changes in the interest costs involved. However, the extent to which banks actually turn to the Fed to satisfy these needs rather than rely on other sources may be significantly affected by changes in the discount rate. In particular, the choice between discounting and the liquidation of an asset depends on the relationship between the discount rate and the yield on the asset.\footnote{In principle, at least, the relevant comparison is between the discount rate and the expected yield over the period of time for which the funds will be required. That is, the comparison should take account of any capital gains or losses. On this point see, Smith, [52, p. 172]} Given the large bank holdings of U.S. governments, banks are likely to compare the discount rate with a rate on one of the short
term securities to see if they wish to rely on the Fed for funds.\footnote{Since in what follows we are going to make no explicit allowance for the Federal Funds market as an alternative for securing short term liquidity, a brief word is due that market. The Federal Funds rate is generally lower than the discount rate, and, in addition, the Federal Funds market can aid a bank to avoid becoming a continuous borrower. However, the Federal Funds market has a number of disadvantages which should be noted. For one, the minimum amount that can be borrowed in this market is one million dollars while the discounting privilege has the advantage that the exact sum, no matter how small, can be secured to cover a reserve deficit. Furthermore, there is no legal limit in borrowing from the Fed while there is a prohibition against national banks borrowing an amount greater than their capital stocks from other sources. In addition, the early closing of Eastern markets makes it difficult on occasion for Western banks to secure Federal Funds late on the last day of the reserve computation period. Finally, however, is the simple fact that many bankers stand in awe of the Federal Funds market and prefer, when the occasion arises, to borrow from their District bank.} We therefore choose to compare $r_d$ with $r_s$, the rate on three month Treasury bills. The two obvious alternatives are a linear relationship $r_d - r_s$ or a ratio $r_d / r_s$. A priori, there is little to choose between them, and hence we shall experiment with both. In addition to serving as a measure of relative costs involved in portfolio rearrangement, these variables also serve in the spirit of the profit theory of borrowing discussed above. In particular, if $r_d < r_s$, the profit theory says banks will increase their borrowings since they have a ready outlet for funds at a higher rate. This effect should strengthen the portfolio rearrangement effect and a priori we expect the signs of both $r_d - r_s$ and $r_d / r_s$ to be negative.
The need theory as noted above emphasizes that banks will borrow only to the extent that they have unfavorable reserve positions, and that these borrowings will be short lived. Open market operations, of course, play a critical role in determining whether there will be an aggregate need for borrowings. However, as stated above, there is no assurance that reserves generated by open market purchases will find their way to banks in need of funds. In particular, since we are working with a two-way classification, we have to distinguish the differential effects that open market operations have on country and city banks. We shall use for our measure of open market operations the variable $D^*$. 

Equation (1) above gives $D^*$ as a function of $\bar{a}$, $R$, $k'$, $k''$, and $d$. $k'$ and $k''$, the average reserve requirements on demand and time deposits depend on both the statutory reserve requirements and the distribution of deposits among the various bank classes. In the short run, at least, the latter can be regarded as given, and hence we can regard $k'$ and $k''$ as determined by the Fed. $\bar{a}$ and $d$ are both bank relative distribution concepts and can similarly be regarded as given. Thus, the only factor significantly affecting $D^*$ is $R$, the total amount of reserves available to the banking system. $R$, however, is the traditional object of open market operations, and therefore we can regard $D^*$ as a similar measure. $D^*$ is of course an all-bank measure, and in order to transform it
into a measure suitable for a sectoral analysis, it was decided to introduce it into the country and city equations as \( \frac{D^*}{D^C} \) and \( \frac{D^*}{D^N} \), respectively. Thus, an increase in reserves and consequently in \( D^* \) will be expected to decrease borrowings in each sector to the extent that reserves are generated in excess of the sector's deposit growth. Hence, we expect the sign of this variable to be negative.

Another variable which we expect to influence the demand for borrowings is the level of excess reserves. This is so for two reasons. First, we have already observed that the simultaneous existence of both excess reserves and borrowing, occurring particularly in the country sector, is a distributional matter reflecting the summing of the positions of numerous banks in different circumstances. Thus, ceteris paribus, the higher the aggregate level of excess reserves, the less likely it is that in the aggregate banks will be finding themselves with short reserve positions. Secondly, the higher the level of excess reserves, the easier it will be to secure Federal Funds, and the lower the level of borrowings will be. This effect should be stronger in the city banks since they make more extensive use of this source of funds. The a priori sign of the excess reserve variable is consequently negative.

One of the early and quite vocal advocates of the profit theory was Robert Turner, who had found that although the profit theory provided a partial explanation of borrowing be-
behavior, there seemed to be a limit beyond which borrowings did not readily go. Turner suggested that as borrowings increased the tradition against borrowing became increasingly operative, tending to restrain further increases. Polakoff has reached similar conclusions in a somewhat more recent study. In order to allow for this effect, it was decided to include a lagged value of the dependent variable in the equation. If this increasing reluctance to borrow is to be exhibited with this variable, we should expect it to have a coefficient between 0 and 1 with a smaller value indicating an increased reluctance to borrow as borrowing increased.

Finally, it was decided that the excess profits tax cited above had served to create a temporary structural shift in the banking sector, and that the inordinate amount of borrowing (relative to apparent need) of the 1952-3 period had to be dealt with in a special manner. It was decided the simplest

1 Turner [57]
2 See [46]
3 We have in mind the following type of situation. Let us assume that borrowing depends on a set of factors denoted by $x$ and we posit that changes in borrowings are composed of two parts, $(\Delta B)^1$ and $(\Delta B)^2$ where $(\Delta B)^1 = f(x_t - x_{t-1})$ and $(\Delta B)^2 = -\alpha B_{t-1}$. We then can write $\Delta B = (\Delta B)^1 + (\Delta B)^2 = f(x_t - x_{t-1}) + (1-\alpha)B_{t-1}$.

Now if we assume that $x$ remains constant and that $f(0)=0$ we have the situation in which equilibrium $B$ tends gradually towards zero, the speed with which it does so depending on the magnitude of $\alpha$. This zero equilibrium is quite sensible in view of the short run temporary nature of the use of the discount privilege. In the long run, assuming conditions represented by $x$ remain the same, the banks will be expected to adjust their portfolios and repay their borrowings.
manner in which to do this was to include a shift variable in the regression which would serve as a proxy for the excess profits tax. In addition to the above five variables, seasonal dummy variables were included in the equations to account for whatever seasonal variation is present in the borrowing behavior.

For noncountry and country banks respectively we have, using a ratio measure of relative costs, the following results where $d_5$ is the excess profits tax shift variable:

\[
\begin{align*}
\frac{B_N}{D_N} &= 35.24 - 4.04 \frac{r_d}{r_s} - 1.76 \frac{E_N}{D_N} - 8.62 \frac{D^*}{D_N} \\
&\quad + 0.430 \left(\frac{B_N}{D_N}\right)_1 - 6.28 d_5; \quad R^2 = 0.781
\end{align*}
\]

\[
\begin{align*}
\frac{B_C}{D_C} &= 26.00 - 0.36 \frac{r_d}{r_s} - 0.22 \frac{E_C}{D_C} - 4.03 \frac{D^*}{D_C} \\
&\quad + 0.398 \left(\frac{B_C}{D_C}\right)_1 + 2.17 d_5; \quad R^2 = 0.719
\end{align*}
\]

The addition of seasonal dummy variables, however, produces the following changes in the two equations.

\[
\begin{align*}
\frac{B_N}{D_N} &= 36.81 - 4.33 \frac{r_d}{r_s} - 1.82 \frac{E_N}{D_N} - 8.97 \frac{D^*}{D_N} \\
&\quad + 0.441 \left(\frac{B_N}{D_N}\right)_1 + 6.42 d_5 + 0.35 S_2 - 0.31 S_3 - 0.23 S_4; \quad R^2 = 0.766
\end{align*}
\]

The variable, $d_5$, assumes the value of 1 in the third and fourth quarter of 1952 and is zero elsewhere.
\[ \frac{B}{D} = 19.93 - 1.18 \frac{r_d}{r_s} - 0.129 \frac{E^c}{D^c} - 3.00 \frac{D^*}{D} + 0.506 \frac{(B^c/D^c)}{D^c} - 1 \]
\[ + 2.27 d5 + 1.14 s2 - 0.68 s3 + 1.0 s4 \] 
\[ R^2 = 0.826 \]

The introduction of seasonal dummy variables in the non-country equation produces little of interest. In fact, all three variables are insignificant and their introduction causes the multiple correlation coefficient (corrected for degrees of freedom) to decline from 0.781 to 0.766. Their introduction in the country borrowing equation, however, produces marked results. In particular, the coefficient of our relative cost variable, \( \frac{r_d}{r_s} \), rises in absolute value from 0.36 to 1.18 and now achieves statistical significance. In addition, the multiple correlation coefficient rises from 0.719 to 0.826. Thus, a pronounced seasonal pattern appears to exist in the borrowing of country banks.

In the results presented below we have replaced the ratio measure of relative cost with a linear differential and have omitted the seasonal variables from the non-country equation.

\[ \frac{B^N}{D^N} = 26.98 - 3.65 \frac{(r_d - r_s)}{D^N} - 1.69 \frac{E^N}{D^N} - 7.06 \frac{D^*}{D} 
\[ + 0.426 \frac{(B^N/D^N)}{D^N} - 1 + 6.19 d5 \] 
\[ R^2 = 0.788 \]
\[
\frac{B^c}{D^c} = 16.86 - 1.33 (r_d - r_s) - 0.134 \frac{E^c}{D^c} - 2.57 \frac{D^*}{D^c} \\
+ 0.496 (\frac{B^c}{D^c})_{-1} + 2.16 d^5 + 1.04 S_2 - 0.75 S_3 - 0.02 S_4; \\
R^2 = 0.854
\]

On the basis of these single equation estimates there appears to be little to choose between the two functional forms for the relative cost variable for the noncountry equation. For the country banks the results slightly favor the linear form which produces a coefficient about four times its standard error as compared with about two for the ratio form and which leads to a multiple correlation coefficient of 0.854 as compared with 0.826 for the ratio form. The final resolution of the issue must await, however, the calculation of our two stage least squares estimates.

Little comment will be made on these estimates since they are preliminary in nature. However, it should be noted that all of the variables introduced have signs which agree with our a priori expectations and achieve a quite satisfactory degree of statistical significance relative to their standard errors. In addition, the coefficients of multiple correlation are sufficiently high to justify inclusion of equations of this form into our larger model. Finally, one tentative comparison can be made. Namely, the elasticity of borrowings with respect to cost factors (of either form) is
higher for the noncountry banking sector. This corresponds to our above characterization of the country banker as a more sluggish portfolio manager. We shall have more to say on this point later.

E. EXCESS RESERVES

Excess reserves comprise the most passive and conservative manner of providing for bank liquidity although it only does so at the cost of income foregone. The larger the volume of excess reserves held by an individual banker the less likely it is that he will have to make trips to the discount window or to the money market in order to secure reserves. Thus, large holdings of excess reserves minimize the chance of having to violate the tradition against borrowing with its accompanying unpleasantness. These holdings also reduce the need for reliance by small or geographically isolated banks on money market banks for transaction purposes.

As the graphs above reveal, American bankers have widely diversified views as to the appropriate level of excess reserves to hold. Country banks appear to view them as a quite appropriate form of liquidity while many city banks appear to follow the principle of minimizing their holdings of excess reserves. With these differences in mind let us turn directly to the specification of our equations explain-
ing the holdings of excess reserves.

As with the case of borrowings, we shall divide the level of excess reserves of a sector by that sector's level of net demand deposits, and our dependent variables shall be $E^N/D^N$ and $E^c/D^c$. We have already observed that a bank holding excess reserves is paying an opportunity cost represented by the yield it could obtain by holding its liquidity in another form. Since the most obvious alternative to excess reserves is holding short term government securities, it is appropriate to approximate this cost by $r_s$, the yield on Treasury bills.

It is true that country banks hold over 85% of the excess reserves, and that we have characterized them loosely as inactive portfolio managers. In spite, however, of this extremely high level of excess reserves that country banks in the aggregate hold, they appear to have manipulated these holdings quite extensively, both secularly and cyclically, and it therefore seems appropriate to examine whether they have done so in accordance with the opportunity costs involved. Some city banks, on the other hand, have followed a policy of excess reserve minimization throughout the period we are examining. These banks generally take hourly inventory checks on their asset position in order to maximize earnings on temporary idle cash. If this type of behavior were uniformly practiced in the city bank sector, we would have little hope of explaining $E^N/D^N$ since it might very well behave like a
random error term. However, the breadth of the classification city bank and the fact that even within a large city, banks similarly situated often behave quite differently with respect to excess reserve policy suggest that we may expect \( r_s \) to be a significant variable in explaining both \( E_N^N/D_N^N \) and \( E_c^c/D_c^c \).  

A second factor which can influence the holdings of excess reserves is the level of borrowings outstanding. That this is reasonable follows from our discussion in the specification of our borrowing equation above. A third factor which might influence excess reserves is the volume of short term security holdings, since they are a substitute for excess reserves. In using this variable, one must exercise some caution. It is certainly true that a bank holding a larger volume of short governments, ceteris paribus, requires less excess reserves in order to meet its liquidity needs. However, it has also been the case that when in a downswing open market purchases have injected additional reserves into the system, banks have tended to utilize these funds by the simultaneous

---

1 One of course might be able to find systematic factors which caused banks to miss the zero excess reserve level at some times more so than at others, and hence one could generate an error theory of excess reserve holdings. This idea might have some validity, especially for large New York and Chicago banks, but it was not pursued.

2 For some limited evidence on differences within a particular city see [20].
purchase of securities and by an increase in the level of their excess reserves. To separate out these two effects, it was decided to include both the volume of short securities held and the change in this volume as variables. The former should exhibit a negative coefficient while the latter, if the change in volume serves to measure the effect of increased reserves, should have a positive coefficient.

Finally, it was decided that a structural change had taken place in the early part of the period under investigation. In order to deal with this via a shift variable, the change must be dated, and for this reason let us briefly examine the events of the early part of our period. Until the Treasury-Federal Reserve accord in the spring of 1951, the Federal Reserve was effectively restrained from practicing active monetary policy. Following the accord, the Federal Reserve remained cautious with its new freedom since there was considerable uncertainty concerning the market's reaction to the increased flexibility of interest rates. Monetary policy remained cautious throughout 1952, and in that period monetary policy probably did not exert a major influence on the economy. In the early part of 1953 the Open Market Committee introduced several important changes in the implementation of monetary policy. For one, open market operations for stabilization purposes were to be confined to the short term market. The second change was the System's policy with respect to the
market for Government securities. In particular the directive was changed from one of "maintaining orderly conditions" to the weaker one of "correcting a disorderly situation", should it arise. Roughly coincident with these changes was the 1953-54 recession in which gross national product fell from a peak level of $368.8 billion in the second quarter of 1953 to a low of $358.9 in the second quarter of 1954. The recession, coupled with these revised policy objectives and tools, finally served to bring out the changes envisioned by the Federal Reserve at the time of the accord. Referring to the period one writer has remarked:

"This (June 1953) marked the end of what one might formally consider as the period of transition to flexible market and monetary policy." ¹

With this in mind we have decided to insert a shift variable \( (d_1, \text{ below}) \) which is one (1.) from the beginning of the period until the second quarter of 1953 and zero (0.) after. Below are two single equation estimates for country and non-country banks.

\[
\begin{align*}
\frac{E^N}{D^N} &= 3.29 - .36 r + .015 A(S^N/D^N) + 2.32 d_1 - .076 B^N/D^N \\
&\quad -.0083 S^N/D^N ; \quad \bar{R} = .860 \\
&\quad (.0039)
\end{align*}
\]

\[
\begin{align*}
\frac{E^C}{D^C} &= 19.08 - 2.15 r + .013 A(S^C/D^C) + 3.34 d_1 - .17 B^C/D^C + .005 S^C/D^C \\
&\quad (.137)(.42) + (.013) - (.009)
\end{align*}
\]

\[
\bar{R} = .836
\]

¹ [34, p. 104]
We will reserve the bulk of the discussion of the results of the individual equations for our presentation below of the two stage least squares estimates. However, several comments are in order at this point. All signs (except for $S^C/D^C$ which is highly insignificant) agree with our a priori expectations. Although some of the coefficients are small relative to their standard errors, the equations generally appear to make sufficient sense to proceed to the estimation of this type of equation in a larger model. There are several additional factors which might be experimented with and they should be mentioned briefly although they shall not be tried until the two stage estimation. In particular, we might add seasonal dummies to the regressions to account for any unexplained seasonal variation. And secondly, we might include a direct measure of open market operations into the regressions, for example, via the $D^*$ measure.

F. SHORT TERM SECURITY HOLDINGS

We now turn to the short term security holdings of banks which comprise the most significant part of the liquidity portfolio. We outlined above the reasons for the existence of this large volume of secondary reserve securities and indicated at that time how U.S. government securities of short maturity were particularly suited for this major liquidity use. In the empirical implementation of this discussion we are
faced with arbitrarily deciding the precise definition of short term. In doing so we were necessarily guided by the available data. Ideally we would wish to use data referring to the current maturity status of the portfolio. We would make no distinction between a newly issued three-month bill and a ten year security with but three months before it becomes due. This type of data is available from the Treasury Survey of ownership but unfortunately not separated into member bank reserve classification. The only other data are quarterly series compiled by the Federal Reserve which, while separating out country and city banks, are listed under the categories of Bills, Certificates, Notes, and Bonds. In view of this it was decided to aggregate bills and certificates in order to construct a short term measure and to aggregate notes and bonds to construct a long term one. This, while suffering from the defects cited above, does preserve the sectoral distinctions which we believe to be of some importance.

1 There are, in fact, a number of additional problems with the homogeneity of this series over time which preclude its use over the entire period of interest.

2 We can derive conditions under which the true short-long ratio and our proxy measure will maintain the same relation over time. In particular, let $S, L$ represent our short and long measures, and let $L_1$ and $L_2$ be the true short and long components of $L$. Furthermore, let these same quantities primed be the measures in another period. For the two measures to bear the same relation over time we must have

$$\frac{S + L_1}{L_2} \div \frac{S' + L'_1}{L'_2} = \frac{S}{L} \div \frac{S'}{L'}$$

This will hold true if $L_2/L = L'_2/L'_1; L_1/S = L'_1/S'$

That is, if (1) the ratio of true longterm notes and bonds to our longterm measure and (2) the ratio of the long term securities which, with the passage of time, have become short, relative to our short term measure, both remain the same, then the two measures will satisfy (1).
Let us now turn to the specification of our short term security equations. The dependent variables, in view of our need for liquidity approach, shall naturally be $S^N/D^N$ and $S^C/D^C$. The first explanatory variables we shall consider are $D^*/D^N$ and $D^*/D^C$, which, it will be recalled, are serving as our measure of open market operations. Open market purchases in excess of those needed to offset any unwanted net negative pressure by the Fed on member bank reserves, and hence increased $D^*/D^N$ and $D^*/D^C$, are typically undertaken when the Fed is following an expansionist policy after a cyclical downturn. The increased reserves with which banks find themselves may not be loaned out for some time, for the economic outlook at this time is likely to engender caution on the part of both the banks and the would-be borrowers. As a result the banks are faced with the allocation of these additional funds, and in part they will direct them to the purchase of short term securities. This will give the banks a return on these funds while they wait for the economic outlook to become brighter (or perhaps merely clearer) and will, in addition, restock the banks' liquidity portfolio, which may very well have diminished in the last cyclical upswing. Similar remarks apply to restrictive pressures which the Fed can apply through open market sales, which decrease $R$ and hence $D^*$. These will tend to put the banks under pressure and may require them to liquidate short term securities to meet increasing loan demands. Thus, in view of these effects we should expect the signs of
both $D/x/D^N$ and $D/x/D^C$ to be positive.

A second consideration which may influence banks' holdings of short term securities is their holdings of long term securities. One writer has maintained that banks, when faced with a liquidity problem, in fact liquidate longer term securities.\(^1\) The argument behind this runs something as follows. If a bank sells short term securities which are its most liquid earning asset and then proceeds to substitute its least liquid asset, loans, it will have suffered the maximum possible decline in its liquidity position. The deterioration of its liquidity position is lessened if the bank sells longer term governments although its liquidity will still be diminished. A bank in fact can maintain its liquidity position by selling more longs than the loan demand it wishes to meet and by purchasing short term securities with the additional funds. Offsetting these liquidity considerations is the greater capital loss that banks must sustain if they sell long terms during a tight money period, but Luckett dismisses this effect as being relatively weak.

While there is certainly some validity in Luckett's point, he seems to overstate bank preoccupation with liquidity and the extent to which they actually sell longer term securities. Thus, for one, part of the liquidity portfolio is held precisely for the purpose of meeting loan demand, and it certainly seems appropriate to sell securities one had planned

\(^1\) See Luckett [32]
on selling when things got tight. Secondly, Silverberg, in examining the Treasury Survey data, has found that a large part of the reduction in bank holdings of long term governments observed by Luckett has arisen through the passage of time and the consequent shortening of outstanding maturities. \(^1\)

Data on bank earnings, however, do show that member banks have realized net security losses of $326 million in 1956 and $211 in 1957. Treasury bulletin data suggest that most of this occurred via sales of one to four year maturities and that the passage of time shortened securities in excess of five years into this category. In 1959 and early 1960 banks were net sellers of long term securities in virtually every month, and they experienced losses of $792 million in 1959, again largely on middle maturities. These sales can be explained in two ways. The first is by appeal to Luckett's argument. The second explains these sales as a result of the special provisions of the capital gains tax as applied to banks. This last named reason creates a link between short and long securities if we make the, not unreasonable, assumption that funds received from capital loss-oriented long term security sales are put, at least temporarily, into short term securities. The reasons offered by the two explanations can, of course, supplement each other and strengthen the negative influence of a long term security variable on short

\(^1\) [51].
term security holdings. In view of this additive effect, there is no need to make a final decision with respect to the reasons for selling long term securities.¹

A final variable of interest relates to the fact that as there was an opportunity cost associated with the holding of excess reserves instead of securities, there is a cost associated with the holdings of securities as opposed to making loans. Thus, ceteris paribus, the higher the loan rate and the larger the differential of the loan rate over the bill rate, the lower the level of short term securities we expect to be held, and hence we expect this variable to have a negative sign. In addition to this variable, we have also included seasonal dummy variables in the regressions and a lagged value of the dependent variable to account for the fact that banks' behavior regarding their short term security holdings may follow a distributed lag with respect to the explanatory variables. The results for noncountry and country banks respectively are presented below.

\[
\frac{S^N}{D^N} = 190.35 + 16.04 S_2 + 24.31 S_3 + 26.61 S_4 - 0.491 D^N/D^N \\
\quad + 78.32 D^N/D^N + 0.589 (S^N/D^N)_{-1} + 8.81 (r_e - r_s) - 52.70 r_e \\
\quad (6.06) \quad (6.07) \quad (6.43) \quad (0.094) \quad (27.64) \quad (0.087) \quad (4.43) \quad (12.16)
\]

¹ It should be noted that nowhere in this thesis do we explain the bank's holdings of long term securities. Explanation of this category would require an exhaustive examination of all components of bank portfolio behavior, and this is beyond the scope of this investigation. However, in the overall portfolio allocations, short and long term holdings alike should be treated as endogenous variables, and by ignoring this feature, we are introducing an element of misspecification into our short term equation.
Some brief comments are in order. Both country and non-country banks appear to allow fluctuations in their short term security holdings to provide for seasonal liquidity needs. The seasonal patterns are somewhat different, but we shall reserve a comparison until we have estimated the entire model and can examine the seasonal patterns in the three liquidity components. Secondly, open market purchases or more explicitly a higher relative level of potential deposits does appear to lead to increased holdings of short term securities, which partially offsets the Federal Reserve's intentions of increasing the actual money supply and contrariwise for attempts at diminishing the money supply. Finally, banks do appear to be sensitive to opportunity costs associated with holding lower (relative to loans) yielding short term securities but not precisely in the manner anticipated. We had expected two costs to be relevant. In particular, as the differential between the loan rate and the bill rate widened, banks would, other things being equal, have an increased motivation to substitute loans for securities.
and similarly as the level of the loan rate rose with the differential remaining the same. The results above bear out our expectation with respect to the level but not with respect to the differential. In the country bank equation the differential has the correct sign but is statistically insignificant while in the noncountry equation it has an incorrect sign and furthermore is statistically significant. This positive sign may reflect the fact that as the differential widens, banks and the prospective borrowers may regard future economic conditions as too uncertain for the granting or requesting of loans. This type of after-the-fact reasoning, however, can be quite dangerous and we shall let the matter rest until a later point.

Finally, we should note the relatively large coefficients associated with the long term security variables. These magnitudes further suggest that an endogenous treatment of long term security holdings may be required.

This concludes our discussions of various liquid assets held by the banks. We now turn to the final section of the chapter which shall examine, from the banks' point of view, the commercial loan market.

G. SUPPLY OF COMMERCIAL LOANS

The market for commercial loans is one of the major linkages between the monetary and real sectors. It offers, potentially at least, a market through which the effects of
monetary policy can be transmitted to the expenditure stream. In particular, from a policy point of view, one is naturally concerned with the effects of Federal Reserve actions on the supply of bank credit and consequently on its price and volume. In addition, the market for bank credit will presumably be a significant component of any mechanism relating monetary policy to the structure of interest rates and then with appropriate lags to long term lending and fixed investment.¹

The Federal Reserve operates on the potential of member banks to carry earning assets, and the immediate effect of these operations is on the supply of credit available in the banking system. There are, of course, many factors in addition to this direct effect which determine a bank's lending capacity. On the other hand, the amount of bank credit demanded, itself, depends on the price of credit and additional factors as well. Thus the mechanism we are after appears, at least to a first approximation, to follow the traditional market interaction of supply and demand forces, and we are faced with the classical econometric problem of estimating supply and demand functions. In what follows we shall discuss the supply function and reserve discussion of the demand function for the next chapter.

¹See, for example, [8] where a preliminary exploration of the market for bank loans to business is described. The primary concern of that study was the mechanism connecting monetary policy actions and the price and volume of bank loans to business.
Let us now turn to the supply side of the commercial loan market. The granting of loans to business borrowers has long been a traditional function of commercial banks. These loans are quite essential to the attracting and maintaining of commercial accounts and, in particular, the availability of bank loans in times of credit stringency is an important banking service necessary to insure retention of these profitable customers. The long run profits of a bank depend to a greater extent on the bank's ability to retain customers who use the essential banking services (e.g., safekeeping and transfer of funds, accurate financial recording, trusteeships, registrarships and loans) than upon skillful short run choices by the portfolio managers among alternative types of earning assets. Thus, in view of the fact that prospective borrowers tend to be among the best long term customers of commercial banks, it has been observed:

"The primary tenet of commercial bank asset strategy is to reserve sufficient lending capacity to meet anticipated loan requests of larger and more durable deposit customers." ¹

The American Bankers Association in a strongly chauvinistic passage offers some non-profit motive reasons for the same type of behavior. In particular, they state:

"Banks, of course, have a clear obligation to their customers and to their communities to make, within the limits of their lending ability, such sound loans

¹ [10, p. 2]
as are needed to finance the growth and development of their trade areas. This loan demand cannot be turned away arbitrarily when the bank finds itself in a tight position. Legitimate customer demand for credit must be met if the community is to maintain its position in the economy and if the bank is to fulfill its proper function." ¹

Before proceeding we should note that the "customer" concept implicit above applies not only to commercial and industrial loans but also applies as well to instalment loans. For example, a large volume of automobile and appliance loans is written directly for the banks by dealers. Attempts to reduce dealer commitments may entail the loss of a profitable account and business relationship. Thus, as in the case of commercial loans one must consider the account potential over the entire cycle.

In any event proceeding from the customer-loan capacity idea let us first consider the simplest form of supply mechanism. Namely, the rate on commercial loans is functionally related to the demand for these loans and the capacity, somehow measured, of the banking system to meet these loan requests. This type of supply function is consistent with the traditional view of the implementation of monetary policy which can best be described by the following sequence of events. In the first instance open market sales decrease the price of government securities and induce asset holders to substitute securities for money in their portfolios. Thus total

¹ [2, p. 277]
liquidity declines, and this is partly reflected in the re-
duction of bank reserves. As a result of these operations, the
supply of private credit is reduced, and consequently interest
rates on private loans increase. Therefore a brake is pro-
vided for total expenditures in the economy.

Under the traditional view the success of monetary
policy in curtailing expenditures depended critically on
the interest elasticity of various types of expenditures.
As economists became increasingly suspect of the strength
of the expenditure-interest rate link, the critics of monetary
policy gained additional ammunition with which to minimize
the effectiveness of traditional monetary techniques. However,
in the last decade there has developed a new theory (to a
significant extent accomplished by individuals connected with
the Federal Reserve System) which has served to reinstate
monetary policy into the arsenal of acceptable discretionary
stabilization devices.

The new theory states that monetary policy transmits
its effects as much by resulting changes in the availability
of credit as through changes in interest rates. The "avail-
ability doctrine", despite early claims, is now understood
simply to mean that the loan rate will be sticky, and that
banks will make adjustments in their loan portfolios slowly,
and consequently that credit rationing will take place.¹

¹For an excellent exposition of the availability doctrine as
a description of market imperfection and credit rationing,
see [41].
Expenditure interest elasticity, while extremely important for monetary policy under the traditional view (and important to minimize under the availability approach), presents no problems for the specification of a supply function. That is, the straightforward supply formulation will still be appropriate even if the last link in the traditional policy chain breaks down. However, what is important for a standard supply formulation is that the price (loan rate) should reflect changing market conditions. The availability doctrine has cast some doubts as to the adequacy of the loan rate in reflecting market conditions. For one, the theory explicitly assumes that loan rates are sticky and that rationing assumes non-price forms. For example, in times of credit tightness when stiffer credit standards are introduced at unchanged explicit interest rates, this is, in effect, an implicit rate increase. This is so since increasing safety requirements for loans at given interest rates means that loans of a given risk are charged a higher interest rate than before. Thus, we see that if market responses are due to a varying mix of the change in rates and the rigidity of non-price limitations, we will mis-specify our system by relying on the loan rate alone. The difficulty in dealing with this matter empirically is that there is no satisfactory quantitative estimate of the degree of credit rationing, and hence we must simply rely on the loan rate as a variable.

This is not nearly as restrictive as it may seem, for while loan rates are sticky, they do fluctuate and in fact do appear
to respond to cyclical pressures. P. Samuelson and W. Smith have in fact both argued that the extra stringency of credit rationing immediately after a tightening of credit policy is a temporary phenomenon. Banks after some time will, Samuelson has stated:

"Do what any normal prudent commercially minded man would do: namely, if a thing is in short supply he will gradually raise the interest charges on it, and let the higher prices help him do the rationing." ¹

In addition it has recently been asserted:

"Pressure of demand on the capacity to meet loan requests causes bankers to welcome a rise in lending rates to ration out the available supply of bank credit to favored borrowers." ²

Thus, we see that the absence of a quantitative credit measure does not preclude investigation of a supply function for commercial loans although it does suggest that there may be lags in the response of the loan rate to demand pressures. With this in mind, let us turn to a specification of the supply schedule for commercial loans.

The first question centers upon the appropriate dependent variable. The straightforward solution is to choose \( r_e \), the rate on commercial and industrial loans, as our dependent variable, and let us temporarily assume we have done so. We can now question the relationship of \( r_e \) with the

¹ Samuelson quoted in [30, p. 33]
² [10, p. 3]
various open market money rates. We have noted above some limited evidence of oligopolistic behavior on the part of the banks. One way in which this behavior manifests itself is in the forced changes of prime customer loan rates, occasioned by changes in open market money rates because at least some borrowers have access to the commercial paper market. While this does link $r_e$ and other money market rates, there is a more fundamental relationship between open money markets and commercial loan market.¹

With respect to this more basic link, D. Alhadeff has noted:

"The significance of the open market inheres not in its size, however, but in its marginal nature and in the high sensitivity which that marginal nature implies. The open market simply measures the broad forces of supply and demand for short term funds in the entire country. The margin, in this view, is analogous to the pressure gauge on a boiler."²

Thus, it is the marginal nature of the open market, i.e., the fact that it is the repository for exclusively surplus funds, which creates an essential link between the loan rate and other money market rates. Since the most important sub-market of the money market is the Treasury bill market, we shall follow Alhadeff in using the bill rate to represent all open market rates in explaining the relation between the open market and the customer loan market. This rate, in addition to measuring supply and demand pressures, will also

¹ Even the strength of this link is limited by the fact that to a certain extent the commercial paper market and loans at commercial banks serve different types of customers.
² [1, p. 134].
serve to measure the return on competing short term assets which are available to the commercial banks. Hence, we have decided that some form of the bill rate should serve as an explanatory variable for the loan rate. It is, however, extremely difficult to work with two interest rates in a single regression equation. This is because they tend to be highly correlated, and although it would lead to substantially higher multiple correlation coefficients, the interpretation of the causal relationships involved would be somewhat unclear. As a result it was decided that a better choice would be to use the differential of the loan rate over the bill rate as a dependent variable and to account for the extent of divergent movement between the two series.¹

If there were no divergent movements, the constant differential between the two rates would be explained perfectly by the constant term in the regression equation, and furthermore the constant would be positive. This would reflect the fact that this differential has historically always been positive, and this in turn can be understood partly in terms of the objective differences between the asset properties of the Treasury bill and the commercial loan, such as risk and

¹ This suggestion can be found in [8,p.117]. In addition, Alhadeff, although not working in the context of a formal statistical model, conducts his analysis by first explaining reasons for similar movements in the two rates and then by examining causes for differences. See Alhadeff, [1, Chap. VIII].
liquidity considerations. These risk and liquidity considerations, however, do not remain constant over the cycle, and it is these variations which contribute to the divergent movements cited above. As Alhadeff has expressed it, if the Treasury bill market were the truly marginal market for surplus funds, and if it was marginal in a passive sense (i.e., simply measuring supply and demand forces), the correlation between the loan rate and the bill rate aside from transitory influences would be perfect. As indicated, however, there are numerous factors which compromise the marginal and passive aspects of the market, and it is these factors which shall serve as explanatory variables for our supply schedule.

One factor which accounts for the nonmarginal aspect of the bill market and which could consequently serve as an explanatory variable is the extent of open market operations. It has been noted:

"Since the central bank's portfolio is managed not for profit but for purposes of credit control, the funds employed in open market operations are hardly 'surplus' in the usual sense." ¹

In our above presentations of single equation estimates of liquidity equations, we found that we had reasonable success in utilizing $D^*$, the potential deposits of the banking system as a measure of open market operations. In view of this we shall include among our explanatory variables both $D^*$ and $\Delta D^*$.

¹ [l, p. 139]
Alhadeff also cites the existence of the Federal funds market and of excess reserves as compromising the marginal nature of the bill market. Thus, for example, he states:

"The experience of the 'thirties demonstrated that when the banking system is holding large excess reserves, the excess reserves, and not the open market investments, are the marginal funds which are the first to feel changes in credit conditions." 1

It seems clear that at least some of the various factors which concern Alhadeff are connected with the lending capacity approach indicated above. There appears to be no obvious measure of the banks' ability to lend, and hence we shall have to construct a variable to incorporate this effect. The government security position of the banks is a natural variable to enter, in some way, into the reserve lending capacity computation. In the day to day operation of a bank the funds necessary to grant a commercial loan are likely to come from loan turnover or from the supply of liquid assets a bank has at its disposal. In the longer run, however, a bank is likely to undertake a more detailed examination of the overall composition of its portfolio and, in particular, of the loan-security balance. If a bank finds its liquidity diminishing to an unsatisfactory low level, it may, as noted above, sell securities whose maturity exceeds one year in order to be able to make loans and simultaneously preserve its

1 [1, p. 138]
liquidity. In view of the fact that banks are more likely to sell longs if they are experiencing a shortage of liquidity, we decided to approximate the measure of lending capacity by the change in the long position. Our expectations are that banks forced to sell longs in order to meet loans are likely to raise their loan rates. This effect will be strengthened by the fact that even if liquidity considerations do not require the sales of longs, banks probably regard commercial loans and long term securities as substitutes. Consequently, a shift in the loan rate relative to the long rate may cause banks to substitute loans for securities in their portfolios, and this will supplement the relationship between the loan rate and changes in long term security holdings. The variable was actually introduced into the regressions as \( A'(O^N/D^N) \), the first difference of the long term security-net demand deposit ratio. Banks sales of long term securities, i.e., \( A'(O^N/D^N) < 0 \) will be associated with a rise in the loan rate. However, there is a greater variability associated with the bill rate in contrast to the loan rate, and hence we would expect rising loan rates to be accompanied by more rapidly rising bill rates, and a consequent narrowing of the rate differential. Since our dependent variable is this rate differential, this independent variable will be expected to exhibit a positive coefficient. Or put in other terms, a sale of long term securities by the banks, which we identify with a decline in their reserve lending capacity, will be
associated with a tightening of credit and a consequent narrowing of the rate differential, which can be identified as a measure of credit stringency. 1

With respect to the passive element of the bill market it should be noted that there are factors which lead to the Treasury bill market playing a role beyond the mere reflecting of demand and supply pressures. Rate changes in the Treasury bill market are an example of both a direct and indirect influence of the bill market on the commercial loan market.

With respect to the former, there is the competing nature of the bill and loan markets, which means that bill market transactions will influence the loan rate, while for the latter there is the fact that changes in the bill rate will affect the loan rate through a change in expectations.

This suggests that the change in the bill rate would be a suitable explanatory variable for $r_e - r_s$. It, however, appears to be the case that the open money markets are more sensitive to changes in conditions that the commercial loan markets, and that, in general, pressures are felt first in the bill market and only with a lag in the loan market. These considerations suggest that we ought to experiment with $\Delta r_s$ and the lagged change in the bill rate as well as with the current value. They also suggest that the coefficient of

1 This cyclical narrowing of the rate differential is discussed in somewhat more detail later in this section.
this variable should exhibit a negative sign. That is, increases in the bill rate, since they occur faster than increases in the loan rate, will be associated with a narrowing of the differential between the two rates, and contrariwise for decreases. It should be noted that this differential speed of movement means that our open market operations variable $D^*$ should have a positive coefficient, since open market sales will increase the bill rate more than they do the loan rate.

Finally, it was decided to incorporate $B^N/D^N$, the borrowing net demand deposit ratio, to serve as a proxy for the strong cyclical component present in our dependent variable. Given the bill rate, of course, one would expect that the loan rate will be higher, the greater is the extent of indebtedness of the banking system to the Federal Reserve. However, when borrowings are high, it is likely to be a time of credit stringency, and the structure of interest rates is likely to be spread over a relatively narrow range. In particular, when $B^N/D^N$ is high, the differential $r_e - r_s$ will be small, and hence the variable should exhibit a negative coefficient.

The variables introduced into this all bank regression actually refer to the noncountry measures for these variables. However, the loan rate as reported by the Federal Reserve represents an average of nineteen large cities, and it seems ap-
appropriate to attempt to maintain homogeneity by using the
noncountry measures. This is further supported by the fact
that the larger banks, which are naturally located in the
major noncountry financial and market areas, account for
the bulk of the commercial and industrial loans.

We first estimated

\[ r_e - r_s = 1.63 + 10.22 A(0^N/D^N) - .051 (B^N/D^N) -.223 A r_s \\
(2.60) 
(.011) 
(.104) \]

\[ + .059 A' D^* + .0045 D^* ; \quad \bar{R}^2 = .736 \]

Seasonal dummy variables were then introduced with the fol-
lowing results.

\[ r_e - r_s = 1.54 + 10.12 A(0^N/D^N) - .048 B^N/D^N - .239 A r_s \\
(2.82) 
(.011) 
(.120) \]

\[ + .065 A D^* + .0045 D^* + .138 S_2 + .052 S_3 + .060 S_4 \\
(.030) 
(.0022) 
(.134) 
(.146) 
(.134) \]

\[ \bar{R}^2 = .724 \]

There appears to be no significant seasonal variation in the
differential of the loan rate over the bill rate. In keeping
with our timing argument above, we replaced \( A r_s \) in the
above regressions with \( (A r_s)_{-1} \) and found :

\[ r_e - r_s = 1.58 + 9.37 A(0^N/D^N) - .047 B^N/D^N - .308 (A r_s)_{-1} \\
(2.49) 
(.010) 
(.102) \]

\[ + .056 A D^* + .0047 D^* ; \quad \bar{R}^2 = .759 \]

\[ (.026) 
(.0021) \]
The lagged value of the variable exhibits a larger (absolute value) coefficient, both absolutely and relative to its standard error. In addition, the multiple correlation coefficient rises to .759 from .736 lending support to the hypothesis that changes in the bill rate are felt more strongly in the loan market after a lag. Finally, the introduction of a lagged value of the level of the loan rate was experimented with producing:

\[ r_e - r_s = 1.35 + 9.76 A \left( O^N/D^N \right) - 0.044 B^N/D^N - 0.331 (A r_s)_{-1} \]
\[ + 0.0097 D^* - 0.153 r_e ; R^2 = .759 \]

This variable added nothing to the explanatory power of the equation and in fact drove up the standard error of \( D^* \) so that this variable no longer achieved the same level of statistical significance. However, in view of the extremely high simple correlation between \( (r_e)_{-1} \) and \( D^* \) (.92), this result is not so surprising. On balance, the third equation presented above appears to offer the best explanation of the differential of the loan rate over the bill rate. Open market operations exhibit the expected effect, and the borrowing-net demand deposit ratio appears to capture the cyclical variation present in the dependent variable. Finally, the change in the long term security-net demand deposit ratio appears to work successfully as a measure of the banking
system's ability to lend. We shall continue our discussion following the two stage estimation.
We have thus far concerned ourselves with bank portfolio behavior and its interactions with the supply of money. Having concluded our single equation estimation of bank oriented equations, we shall now turn to the nonbank sectors of the economy and a discussion of factors affecting the demand for money. In particular, this chapter shall investigate the private demand for commercial and industrial loans, inventory investment demand, and fixed investment demand. This last discussion will introduce a long term interest rate into the model to account for part of the variation in fixed investment, and we shall consequently devote the final section of this chapter to a brief examination of interest rate structure. A discussion of the demand for money itself and of the specification of our income equation will be reserved for the next chapter.

A. DEMAND FOR COMMERCIAL AND INDUSTRIAL LOANS.

Before discussing the theoretical aspects of the demand for bank loans, some data exhibiting business use of such funds shall be presented. Although the principal source of funds for American business has been equity finance, between 35 and 40% of business assets have been obtained by the use
of borrowed funds. Of this, business loans of commercial banks accounted for roughly half or 19% of the indebtedness at the end of 1959. In addition, the Federal Reserve has estimated that in the fall of 1957 there were between 1 and 3/4 and 2 million separate bank loans outstanding as compared with a total business population of about 4 million firms. These data give a suggestion of the extensive number of businesses that rely on banks for at least part of their credit.¹

In discussing the demand for business loans, one is faced with a two part issue. First, one must consider the factors which generally necessitate the securing of external funds by business. Second, one must inquire after the reasons for choosing bank financing rather than some alternative means of external finance. The demand for external funds on the part of business is the result of a complex set of economic calculations coupled with, or rather constrained by, a set of beliefs concerning the efficacy of external finance. A firm’s current cash outflow is a result of numerous factors including its wage bill, its decisions with respect to the level of inventories deemed desirable, and its current and past decisions with respect to the volume of capital outlays on plant and equipment. The inflow items (retained earnings and depreciation allowances) depend in part on profits

¹ [2, pp. 123 - 4]
and consequently sales and serve to determine, when considered relative to expected outflows, a firm's capital requirements.

It seems natural to presume, as other writers have done, that there exists a causal relationship between the strain on a firm's cash position and the pressure to secure external finance.¹ For example, in the postwar U.S., manufacturers' dependence on external funds has displayed a marked cyclical variability, being relied upon mainly in the later stages of the cyclical upswings when cash positions became tight. Meyer and Kuh have suggested that this element of involuntary liquid asset reduction late in the boom can result from projected fund flows falling below expectations or capital outlays becoming unexpectedly large.

There are of course a variety of external sources of funds available to business. In addition to bank loans, there are opportunities for trade credit, bond financing, and direct placement of commercial paper. One cannot strictly look at the nominal rates of these various alternatives in order to determine their relative costs. Trade credit generally, however, appears to be the most costly method. Under typical terms 2% may be deducted from a bill if cash is paid within ten days; otherwise the face amount is due in thirty or sixty days. If due in thirty days, the effective rate is 36.5% per annum and if due in sixty days, the rate is reduced to 14.5%.

¹ Meyer and Kuh; [39]
However, in some cases payment can be deferred for longer periods of time, or suppliers can make special arrangements with customers, which further reduce the effective rate.  

Bond financing requires, in addition to payment of the nominal rate, that a firm cover the cost of the flotation. More serious, however, is the fact that the success of bond placement operations depends to a marked extent on the reputation of the issuing company. This naturally presents a problem for a wide class of firms including newer and smaller businesses. Finally, it should be noted that bond sales are not considered an appropriate method to use for direct financing of working capital. Commercial paper finance does not meet with this last objection, and in fact the prime commercial paper rate is generally significantly lower than the bank loan rate and also the corporate bond rate, although it does have certain issuing costs. The major problem with this method of finance for most firms is that access to the commercial paper market is limited to relatively few firms of widely recognized standing.

Bank loans, while carrying a higher rate than the alternatives noted above, are available to a wider class of borrowers. In particular, it will be recalled that surveys have found the typical business firm borrowing from a bank

---

1 See [2, Chapter 4] for a more extensive discussion of this point.
to be of less than average profitability. Thus, the alternative financing methods are, to some extent, serving different types of customers. There are certain other features of bank borrowing which should be mentioned. For one, to the extent that receiving a loan demonstrates that a firm has met certain objective standards, the proven ability of a firm to borrow from a bank may enhance its reputation. Second, there is the feature of the compensating balance by which we mean deposit balances required of a borrower by a bank as a condition for granting a loan. Such balances, to the extent they exceed the average balance a firm would voluntarily choose to hold, serve to increase the effective rate of interest charged on loans. In addition, these balances are actually irrational from the point of view of the bank, since required reserves are increased by the compensating balance. ¹ The existence of these balances may present a problem in using the loan rate as an adequate measure of the price of obtaining a loan. ² The American Bankers Association has noted that required balances are likely to be higher and more

¹ For a more detailed examination of this point see [13] and references cited there.

² Another, and perhaps more serious, inadequacy of the loan rate as a cost measure is suggested by the recent development of a credit availability theory which emphasizes nonprice rationing methods. For a discussion of this point see Chapter 2, section G.
rigidly enforced when rates are high. Voluntary balances are likely to decrease in times of credit stringency, and since the rate equivalent of a compensating balance depends on the required balance considered relative to the voluntary balance, it seems probable that under such conditions the loan rate will be understating the cost of obtaining a loan.

Finally, there are a number of helpful services which a bank makes available to its loan customers, such as advice on the current local business outlook. However, this type of "service" will be quite undesirable to a firm if it is extended to become a form of bank control. Thus, in the case of a term loan it may be required that the firm enter into a formal agreement under which the bank may impose certain conditions and restrictions on the operations of the borrower. For example, the firm may be required to maintain a specified working capital position, to submit regular financial reports, and may have limits placed on other borrowing and capital expenditures or sales of assets. It is precisely these sorts of restrictions which make internal financing attractive to many firms.

Bankers have generally found variations in the demand for bank loans, arising from changes in inventory, accounts receivable, and equipment requirements, with inventory fluctuations being the dominant factor. In addition to these sources of demand, there are numerous seasonal and other short term factors which contribute to bank loan demand. For example, financing interest payments on bond issues or
coverage of capital outlays while long term financing is being secured can both generate a demand for bank loans. A summary of bank credit conditions taken from a recent Federal Reserve Bulletin serves to point up the factors to which loan demand is generally attributed and also indicates the nature of the competing finance arrangements available. In particular, it is noted:

"The slower growth in business loans may reflect in part the less rapid rise in inventory investment in the current upswing than in earlier ones. Plant and equipment outlays also have increased more slowly. And with the expansion in retained earnings and the continued growth in depreciation allowances, substantial amounts of internal funds have been available to cover financing requirements. Furthermore, with rates on financing in capital markets more favorable than on bank loans, corporations have relied to a considerable extent on long-term financing, and some firms - particularly public utilities - have funded bank debt". 1

A speech by Chairman Martin of the Board of Governors of the Federal Reserve System before a subcommittee of the Joint Economic Committee, dealing with inventory changes, is also reprinted in the same issue of the Bulletin. In it he asserts:

"Additionally, bankers have traditionally regarded inventory needs as one of the most legitimate reasons for borrowing, and they consider the meeting of such needs as one of the most appropriate forms of bank lending." 2

Let us now turn to the specification of our demand equation. First, for our dependent variable we shall use ACL_t, the first difference in the volume of commercial and in-

1 [21, July 1962, pp. 793-4]
2 [21, July 1962, p. 810]
dustrial loans outstanding at the end of quarter $t$. There is, it should be noted, a certain minor theoretical objection to this variable in that loan surveys taken on specific dates will miss intermittent borrowers. Thus, as the American Bankers Association has noted:

"In a sense, even without a change in the total, bankers provide a large pool of revolving credit for business."  

Hence, there may be a difficulty in evaluating, from the change in the volume of loans, the use that any single borrower or group of borrowers has made of the available credit. This objection, while carrying weight for first differences of annual stock data (the context of the above comment), is not at all serious for quarterly data. This is so since we shall miss a loan only if it begins and terminates within a quarter, and the quantitative effect of loans satisfying this condition is likely to be small.

In view of the above discussion we shall include among our independent variables, explaining the volume of commercial loans, the amount of inventory investment $A_t$ occurring during quarter $t$.  

---

1 [2, p. 125]

2 It should be noted, however, that the inclusion of this variable in the loan demand equation is a separate issue from the inclusion of a credit-cost variable in an inventory investment equation. That is, an inventory demand schedule which is interest inelastic within the relevant range of operation is still consistent with inventory induced loan demand although it will create problems for the traditional implementation of monetary policy. We shall return to this question when we examine inventory investment in more detail later in this chapter.
fluence the demand for loans is the cost of these loans. However, since large corporate borrowers have access to money and capital markets as well as to commercial banks, it is important to allow for price substitution effects between bank loans and these markets, as well as allowing for the cost of the bank loan itself. With respect to this substitution effect, there are several possibilities. The simplest is to regard a particular rate, say the rate on prime commercial paper, \( r_c \), as the base rate and to consider the differential \( r_e - r_c \) of the loan rate over this rate as the relevant cost. This, however, has the disadvantage of introducing an additional variable \( r_c \) into the system. If we were willing to treat it as exogenous, it would create no problem, but since \( r_c \) moves very much like the short term government rates, we are reluctant to treat it as such. This empirical fact suggests another alternative and that is to use \( r_s \), the rate on three month Treasury bills, as a proxy for the cost of borrowing outside the loan market and to introduce \( r_e - r_s \) as our appropriate differential cost variable. In the results presented below, both differentials were experimented with as was a pure measure of the cost of the loan.

A third factor which will be used to explain \( \Delta CL_t \) is \( \Delta Y_t \), the first difference in the level of money gross national product. It is the purpose of this variable, in part, to reflect changing expectations of the businessmen who generate the demand for loans. In a real sense, it serves an accelerator
function, not unlike that played by changing levels of income in inducing, in the traditional presentation, private investment. ΔY also serves as a proxy for specific activities (other than inventory investment which we have explicitly allowed for) which contribute to the demand for commercial loans. The coefficient of ΔY as with that of ΔH is expected to exhibit a positive sign in our regression equations.

Finally, as in our other equations, we shall introduce dummy variables in order to be able to examine the seasonal pattern of the demand for loans. The results of these estimations are presented below.

\[ A_{CL} = -0.031 + 0.341 S_2 + 0.621 S_3 + 0.986 S_4 + 0.00023 ΔH_t \]

\[ = -0.053ΔY - 0.341 (r_e - r_c) \]

\[ R^2 = 0.666 \]

\[ A_{CL} = 0.263 + 0.366 S_2 + 0.613 S_3 + 0.928 S_4 + 0.00025 ΔH \]

\[ = 0.47ΔY - 0.303 (r_e - r_s) \]

\[ R^2 = 0.666 \]

There appears to be virtually no difference created by using the rate on short term bills instead of the technically more appropriate rate on prime commercial paper. The introduction of the loan rate per se into both of the above equations did not lead to any significant changes as can be observed from the representation of one of the estimates below.
The results on the whole appear quite sensible, and although the percentage of variation explained by this equation is not as high as some of our other preliminary results, the signs and magnitudes of the various coefficients clearly warrant further investigation of this type of result. We now turn to a discussion of inventory investment.

B. INVENTORY INVESTMENT

In dealing with inventory investment as with each of the other components of our model, it is clear that a complete examination of the subject would require a relatively extensive amount of disaggregation. In particular, one might provide separate explanations for inventories of retailers, wholesalers, manufacturers, and others; separate durable goods from non-durable goods; and treat work in process, raw material, and finished good inventories separately. However, in view of the resources and time which constrain this investigation, it was decided to concentrate on the category of manufacturers' inventory, since this classification looms large in the volume of inventory investment and has played a critical role, via its fluctuations, in the generation of postwar business recessions. The model utilized is a flexible accelerator
buffer stock one which has become quite standard in the literature and is presented somewhat briefly below.¹

The following variables will be utilized in this section.

\[ S_t \] : sales during period \( t \).

\[ \hat{A}_t \] : anticipated sales during period \( t \) (formed during period \( t-1 \))

\[ H_t \] : inventories at end of period \( t \)

\[ H^p_t \] : inventory planned for the end of period \( t \)

\[ H^e_t \] : equilibrium level of inventory

\[ U_t \] : unfilled orders

The most elementary form of the acceleration principle relates the desired level of the stock of inventories to the volume of sales. It is clear, however, that this equilibrium level of stock may depend on other factors as well as sales. In particular, it may depend upon such factors as a monetary variable (for the time being denoted as \( m_t \)) and on the extent of unfilled orders. While entrepreneurs may have precise plans for production in the next period, they may also consider a somewhat extended horizon in deciding upon the change in stocks to be made in the current period. As Lovell has expressed it:

"If unfilled orders represent an established demand, indeed a possible committal to deliver at some future date, entrepreneurs may well consider it advisable to carry additional stocks when unfilled orders are large

¹ See, for example, Lovell, [31], and the references cited there.
as a hedge against possible shortage and price com-
ments." 1

Darling has elsewhere suggested that the change in unfilled
orders should be considered in explaining the behavior of
total inventory holdings. 2 Given these additional consid-
erations, we can write the equilibrium level of inventory
as:

(1) \( H^e_t = a + \beta_1 S_t + \beta_2 U_t + \beta_3 A U_t + \beta_4 m_t \)

Now, of course, actual sales are not known by the firms in
advance of output when the production decision is made.
Therefore, a planned level of inventory may be defined by
substituting anticipated sales into (1). Actual end of
period inventories will naturally deviate from planned in-
ventories by extent of the error of the sales forecast,
and hence we can write:

(2) \( H_t = H^D_t + (S_t - S_t) = a + (1+\beta_1)S_t - S_t + \beta_2 U_t + \beta_3 A U_t + \beta_4 m_t \)

This buffer stock model can now be coupled with a flexible
accelerator by assuming that firms only attempt to partially
adjust their inventory to the new equilibrium level. In
other words we write:

---

1 [31] Actually, the rationale for an unfilled orders
variable in an inventory equation must be examined in the
context of a somewhat more detailed model which con-
siders both production and inventory decisions and their
interactions. For an example of this type of investigation
see [9].

2 [12]
(3) \[ H_t^p = H_{t-1} + \alpha (H_t^e - H_{t-1}) \]

where \( \alpha \) is the reaction coefficient. And as above we can write:

\[
(4) \quad H_t = H_t^D + (S_t - S_t^*) = \alpha H_t^e + (1-\alpha)H_{t-1} + S_t^* - S_t = \alpha \delta + (\alpha \beta_1 + 1)S_t^* - S_t^* + (1-\alpha)H_{t-1} + \alpha \beta_2 U_t + \alpha \beta_3 \Delta U_t + \alpha \beta_4 m_t
\]

The sales expectation variable is not directly observable, and before using (4), we must somehow account for this variable. Following Lovell, we shall let expected sales be an internally weighted average of sales in period \( t-1 \) and in period \( t \). Thus

\[
(5) \quad S_t = \lambda S_t + (1-\lambda)S_t^* = S_{t-1} + \lambda(S_t - S_{t-1})
\]

That is, \( \lambda \) represents the fraction of the change in sales actually anticipated. Substituting (5) into (4), we have

\[
(6) \quad H_t = \alpha \delta - (1-\lambda)(1+\alpha \beta_1)(S_t - S_{t-1}) + \beta_1 H_{t-1} + \alpha \beta_2 U_t + \alpha \beta_3 \Delta U_t + \alpha \beta_4 m_t
\]

The final problem concerns itself with the monetary variable \( m \) which is as yet unspecified. Before specifying it, however, we shall briefly discuss the interaction of monetary policy and inventory investment. There are a number of arguments typically advanced when discussing the effectiveness (or rather lack of same) of monetary policy.
on inventory investment. Thus, it is argued that corporations in the postwar period have had surplus liquidity which they have gradually decreased to help, in part, the financing of inventory accumulation, and this has made corporations relatively immune to credit conditions. Secondly, it is argued that in addition to this secular offset to credit policy, there is also a cyclical offset due to the extension of trade credit, the growth of internal funds, and of accounts receivable, simultaneous with the accumulation of inventories. For example, Meyer and Kuh cast some doubt on the need for bank finance when they note:

"It seems, moreover, that the financing of inventories in the phase of most rapid accumulation, (early recovery) even though assisted by bank lending, could proceed at a rapid rate without much borrowing because of a very large coincidental generation of internal funds." 1

Thirdly, it is claimed that the interest cost is only a small fraction of all other costs involved in carrying inventories, and hence businessmen ignore these interest considerations. This is particularly true since inventories are held for such a short period of time, and for shorter lived investments capital costs are a smaller fraction of total costs.

Fourthly, it has been argued that expectations of rising prices have offset much of the deterrent effect of rising interest costs. And finally it is claimed that the availability of business loans may be relatively insensitive to changing

1 [39, Chap. IV, pp. 1-2]
credit conditions over the cycle. That is, banks, by virtue of viewing business loans as their most appropriate form of loan, may absorb the prevailing credit tightness in other components of their portfolio. As Chairman Martin has noted:

"Banks often elect to provide for such needs by reducing portfolios of liquid and even long-term securities and, on occasion, by limiting mortgage, security, and other non-business lending. Business loans are the bread-and-butter business of many banks and it is evident to them that a dissatisfied business customer can be lost forever to competing lenders." 1

Despite these arguments there are some reasons for believing that monetary policy can have some impact on inventory investment. For one, inventory decisions, in contrast to those concerning fixed investment, are divisible in nature, and this facilitates small adjustments appropriate to relatively small changes in credit conditions. Secondly, the short run nature of the decision may aid monetary policy to the extent that interest rate changes will be less swamped by risk considerations. Thirdly, there is the fact that businessmen can reduce the level of their inventories (whereas gross capital fixed investment must be nonnegative), and this facilitates adjustments in inventory positions. Finally, the average lag between inventory decisions and purchase of materials is relatively short, and this can further aid credit policy.

1 [21, July 1962, p. 810]
After adding up the yeas and nays, Martin contends:

"....it seems to me that credit conditions do at times significantly influence inventory policies. Moreover I think it reasonable to believe that the potential influence of these conditions is greater now than in earlier postwar years, because interest costs are a larger proportion of total inventory costs and firms have generally become less liquid and therefore more dependent on credit." 1

Meyer and Kuh on the other hand feel:

"Manufacturing firms are ordinarily in a comfortable position to finance the greatest part of their requirements from internal sources because a rapid inflow of internal funds and a very sharp increase in accounts payable normally coincides with inventory accumulation. A tight monetary policy at this juncture of events not only would normally be considered undesirable but if put into operations would presumably have small effect." 2

Of course, the pertinent cost for inventory investment financed out of retained earnings or depreciation allowances or reduction of liquid assets is the opportunity costs associated with alternative uses of these funds. Thus, for example, if the opportunity cost moves like the Treasury bill rate, it will fluctuate more than bank lending rates, and perhaps changes in opportunity costs may have more of a leverage on inventory policy. Furthermore, if the Fed became restrictive in the early stages of the cycle, they might find that their actions resulted in effects with differences in both timing and magnitude from those anticipated, but there is no reason

1 [21, July 1962, p. 810]
2 [39, Chap. IV, p. 3]
to suppose that restrictive action of any sort would be impossible. For example, if diminished external credit forced firms to use internal funds for inventory accumulation, this might curtail expansion in plant and equipment at some future time. The exact effect would depend on the lag of monetary policy, the predictive confidence of the monetary authorities, and the nature of the credit restrictiveness among other factors. Finally, in the implementation of monetary policy there is the question of whether credit restrictions aimed at reducing inventory fluctuations can be directed towards the industries or firms whose inventory behavior is contributing destabilizing effects to the economy. There is very little evidence on this point although Eisemann has indicated there may be some difficulties in this direction.

On balance, definite conclusions are difficult to reach by theoretical reasoning and some recourse to empirical examination is required. However, even empirical investigations of this problem are beset with many difficulties. Foremost is the problem of exactly how one chooses a monetary variable to include in the model. One could simply settle for the rate on commercial loans as a variable, but this overlooks the opportunity cost notion suggested to be relevant. Furthermore, there is the widely held belief that monetary policy works as much through nonprice rationing of loans by the banks

\[1 \text{[18]}\]
as through changes in interest rates. Unfortunately, as noted above, there is no numerical measure of the degree of credit rationing characterizing the market for bank loans. As has been suggested elsewhere, one possible alternative instead of the loan rate is to directly use a monetary policy variable.¹ Both alternatives were tried, and the results are presented below.

Secondly, there is the problem in that inventory regression studies necessarily use time series data that are highly correlated with each other because of common trend and cyclical components (e.g., stocks of inventories, sales, and loan rates). Thus, problems of multicollinearity and its various computational consequences are very likely to present themselves. Finally, there are problems connected with the adequacy of the inventory data themselves. In particular, there is the problem that inventory data not only reflect conscious management decisions, but also reflect involuntary changes. In fact, intended inventory changes tend to bring along with them unintended changes in the opposite direction. For example, planned reductions by one firm can cause an unintended decrease in sales and consequent increase in inventory of the firm's suppliers. This and other data problems can obscure underlying effects. With these considerations in mind let us turn to the results of some single equation experiments.

¹ [8, pp. 90-91]
The first implementation of (6) above used both the level of the loan rate and the first difference of that level as monetary variables. In addition, following a suggestion in an article by Duesenberry, Eckstein and Fromm we also added $A H_{t-1}$ to the equation. The results were:

$$A H_t = -737.15 - 559.07 S_2 - 608.24 S_3 + 433.98 S_4 + 137.94 S_t$$

$$(268.8) (230.9) (295.3) (33.6)$$

$$+ 3.49 U_{t-1} + 128.50 AU_{t-1} + 615.68 r_e - .093 A S_t$$

$$(7.8) (26.8) (44.9) (.041)$$

$$- 232.74 H_{t-1} - 357.92 r e + .198 A H_{t-1}$$

$$(47.7) (667.6) (.085)$$

$$R^2 = .841$$

The coefficients of the two interest rate variables and that of the level of unfilled orders are all insignificant, with the level of the loan rate further exhibiting an incorrect sign. An examination of the correlation matrix reveals that extremely high intercorrelations exist between several of the independent variables. In particular, the simple correlations between sales and lagged inventory stock, sales and the loan rate, and the loan rate and inventory are .93, .94, and .96 respectively. In view of this the equation was rerun omitting the level of the loan rate and the level of unfilled orders, and this yielded:

1 See [17]

2 $A H_t$, $A H_{t-1}$, $A S_t$ are in millions of dollars while $S_t$, $U_{t-1}$, $AU_{t-1}$, $H_{t-1}$ are in billions.
\[ A H_t = -495 - 509 S_2 - 587 S_3 + 534 S_4 + 155 S_t + 0.197 A H_{t-1} \]
\[ + 121 A U_{t-1} - 0.110 A S_t - 53 A r_e - 206 H_{t-1}; R^2 = 0.841 \]

which still has an insignificant money variable. Substitution of \( r_e \) for \( A r_e \) produced similarly negative results.

Finally, it was decided to use \( D* \) and \( A D* \) as a measure of the monetary variable, and this produced the following:

\[ A H_t = 45 - 658 S_2 - 662 S_3 - 409 S_4 + 168 S_t - 0.111 A S_t \]
\[ - 189 H_{t-1} + 129 A U_{t-1} - 30 A D* - 12 D* + 0.135 A H_{t-1} \]
\[ R^2 = 0.845 \]

where the coefficients of \( D* \) and \( A D* \) are both insignificant with the wrong sign.

The results of these experiments, while further supporting the suitability of a flexible accelerator buffer stock model for explaining manufacturers' inventories, offer no support for the direct influence of a monetary variable on inventory investment. There are, however, several difficulties with the above formulation which could conceal the effects of monetary variables on inventory investment. Firstly, our choice of a monetary variable may be inappropriate. Monetary policy with respect to inventory may in fact work via credit rationing effects, and we have not
allowed for these market imperfections. Secondly, the high intercorrelations among several of the explanatory variables may create difficulties for the proper evaluation of the economic forces involved. This is the sort of difficulty we discuss below in the case of plant and equipment investment, and we there advocate a functional transformation to eliminate the problem. Lack of time prevented this from being tried in the present instance. Thirdly, there is the problem of simultaneous equations bias which may obscure any monetary effects. Thus, an increase in inventory investment will lead to an increase in the demand for commercial loans and this, within the same quarter, can lead to an increase in the loan rate creating a positive association between inventory investment and interest rates. Finally, there is the possibility that our analysis is being conducted at too aggregate a level. For example, industry data might yield more significant results. We reserve final judgement of this issue until after our two stage estimation and turn now to a discussion of fixed investment.

C. FIXED INVESTMENT

Our main interest in examining fixed investment stems from the relationship of this component of gross national product to the monetary sector. More precisely, we are interested in examining the effects of monetary variables such
as interest costs on expenditures on plant and equipment, with an eye towards investigating the policy implications of this link. There are numerous lags which occur between the initial actions of the monetary authorities and the subsequent effect (if any) of this link on income. In particular, there is the lag from the initial policy action to its effect on the relevant monetary policy variable. Secondly, there is a lag between a change in this variable and its effect on investment decisions. And finally there is a lag between the decision to invest and the actual production of capital goods and the consequent generation of investment expenditures. This section will examine the final two links while the next will concern itself with the first one.

There are two possible modes of attack. The first is to directly relate monetary variables and investment output, while the second would examine each of the two links separately and generate a two echelon explanation of the influence of monetary variables on expenditures. The latter approach is in fact the one adopted in the CMC study paper to which we have made reference above. Each approach has its empirical shortcomings. For example, the first suffers from the fact that many investigators adopting it have failed to detect a significant interest elasticity of investment demand, while the second must somehow approximate

\[ [8, \text{pp. 67-8}] \]
the investment decision notion which is not statistically measurable from available data.\(^1\) In what follows, we have decided on the direct single stage approach, but before presenting our results, it is appropriate to discuss the general arguments concerning the interest-investment links and to present some reasons for the lack of empirical evidence supporting the existence of a significant interest rate effect on investment.

The literature on fixed investment and its interest elasticity while voluminous is as yet inconclusive as to the precise determinants of investment and the role that interest costs play in that determination. It has been often argued:

"In view of the general nature of investment decisions, there are some lines of theoretical reasoning which would suggest a priori that the effects might be expected to be weak. And, finally, there are some features of the institutional framework within which investment activity is conducted which tend to weaken the effects of interest rates on investment."\(^2\)

One argument advanced from a crude examination of the basic data observes that interest rates and investment have tended to move in the same direction, and hence it is concluded that interest rates do not effect investment. It is,\(^1\)

\(^1\) The exception to this appears to be the National Industrial Conference Board data which provides observations on certain types of investment decisions. These data are inappropriate for our purposes but certainly appear to merit independent investigation.

\(^2\) [58, pp. 368 - 9]
of course, clear that this partial equilibrium analysis does not enable one to draw any valid conclusions concerning the interest-investment link. For example, one might explain the phenomenon by noting that investment depends on other factors, and at such times these factors are likely to lead to increased investment demand which might have been greater had not interest rate increases slowed down the expansion.

An institutional fact which is said to weaken the effect of monetary policy on business investment is the heavy (about 65% of all funds) reliance of firms on internal finance. In principle this is an opportunity cost calculation, and a firm should compare the return on internal funds obtained by a capital good expansion with the return obtainable in alternative uses. This latter alternative clearly depends on prevailing interest rates, but is argued in practice that such comparisons are rarely made. For example, it has been stated:

"Prospective returns from capital projects that might be under consideration are so high relative to returns on safe financial assets (such as Government securities) that the comparison is of little relevance and outside investments involving substantial risk require continuous attention and divert the energies of management away from the firm's main line of business." 1

In addition it has been assumed:

1 [58, p. 371]
"The high uncertainty about the outcome of an investment - particularly about the results after the first year or so - made the expectation of very high returns a prerequisite to the undertaking of any project. The minimum acceptable rates of return would be so high and subject to so wide a margin of error that changes of one or two percentage points in the cost of (money) capital could be neglected. In fact, it could be rationally concluded that the great height of required returns made efforts at quantification superfluous: acceptable projects were obviously acceptable; borderline cases were by definition unacceptable." 1

Despite all these claims, it appears that uncertainty or at least the role it plays in decision making has diminished somewhat since the depression dominated prewar and early postwar periods. One of the more vocal proponents of the interest sensitivity of investment, William H. White, has further stressed that rapid increases in the use of scientific management techniques have occurred since 1955. He has cited broad survey evidence to support the hypothesis that elaborate financial, sales and capital spending planning has been undertaken by many of the larger firms. This extensive evidence suggests that the conditions under which economists originally investigated investment determinants have changed, and hence some of the widely cited empirical evidence has lost some of its validity for the present. Thus White argues that these advanced management techniques coupled with financial pressures which lead to the acceptance of lower rates of return create a more favorable environment.

1 White, [60, p. 1]
for an interest rate effect on investment. For example, as early as 1955 a survey found that 41% of the respondents took account of the interest rate in calculating the profitability of self-financed investments, and it can be assumed that many more did so where investments using borrowed funds were concerned.¹

Hence, on balance, the matter of a significant interest elasticity of investment demand appears to be in a state of flux, with the experience of more recent years pointing towards a positive resolution of the problem. Since our empirical investigation has the benefit of seven years of post-1955 data, we are hopeful of formulating a one stage model exhibiting a significant interest rate variable. The fact that several more recent studies have found such effects further supports this position.² Early empirical studies, in addition to examining a period in which negative conclusions concerning interest rates may have been justified, further suffered from certain technical difficulties, which tended to add to the strength of the negative conclusions. Before turning to our own investigation, it is appropriate to indicate briefly some of the difficulties with these early regression model studies.

Interest rates in the early postwar period exhibited very little movement of either a cyclical or secular nature.

¹ [60, p. 20]
² See [24] and [15]
and in addition remained at relatively low levels. This can be readily observed by examining the rate on long term U.S. bonds which was 2.09% in the first quarter of 1946 and 2.19% in the fourth quarter of 1949. Its peak value in this period was 2.45% in the third quarter of 1948, and this was not exceeded until the second quarter of 1951 which, it will be recalled, marks the date of the Treasury-Federal Reserve Accord. This limited variability of interest rates and their low levels (relative to the return on other opportunities available to postwar firms) probably contributed, in part, to their lack of success as an explanatory variable. However, recent movements of this variable should remove some of this difficulty for contemporary investigation.

In later periods when interest rates began rising and exhibiting increased cyclical variability, regression studies examining investment typically found profits and sales to be the major explanatory variables and still found no role for an interest rate. However, in using profits, sales, and interest rates in a single equation, investigators were working with strongly intercorrelated variables, which lead to problems of multicollinearity and consequent difficulty in disentangling the effects of the different variables. In

1 The extreme case of introducing a variable with zero variance, in addition to a constant term, would lead to a singular moment matrix.
order to allow an interest variable a fair chance to exhibit explanatory power, one must insure that this variable can be clearly identified in a regression equation, and early studies often made this identification extremely difficult.

Another qualification to early studies of investment behavior is that they ignored the simultaneous nature of the problem, thus producing both biased and inconsistent estimates. Thus, for example, an autonomous increase in total demand might lead to an increase, via the accelerator, in fixed investment. This autonomous increase would be likely to produce a roughly coincident increase in interest rates, thus producing a positive association between investment and interest rates.

A final difficulty relates to the fact that investment studies generally used investment expenditures rather than working with a decision variable as a dependent variable and simultaneously worked with roughly contemporaneous interest rate effects. It is, however, more reasonable to expect that interest rate effects (and the effects of other variables) will be felt on investment at the time of the decision making process. A decision to acquire a capital good at a given time will generate a distributed expenditure stream from that point on. The particular pattern of the stream will determine the relevant lag structure for the ex-
planatory variables. Thus early studies, by ignoring this lag problem, had further misspecified their models. It should also be noted that the use of expenditure data may also have accounted for part of the success of internal funds as an explanatory variable. Thus, once a firm has made a decision to invest, it knows it will have to disburse funds at future dates and hence may begin accumulating internal funds for this purpose. This after the fact accumulation may then show up as a variable explaining investment. One could argue, however, that the investment decision was influenced by the expected future availability of internal funds, and we suspect the truth is a combination of these two effects. With all these considerations in mind let us turn to the specification of our investment equation. 1

Let us, somewhat informally, imagine that at a certain time businessmen look ahead a number of time periods and generate a set of expected economic variables relevant for inclusion in some multi-period objective function which is

---

1 It has recently been argued that what is relevant for the investment decision of a firm is its cost of capital considered in relation to the market rate of return, and that interest rates may provide a poor approximation to this comparison. For example, changes in interest rates may affect the cost of capital and the market rate of return in different ways and with different lags, and this will not be captured by looking at an interest rate variable. For a formal analysis along these lines see [40]. It should be noted, however, that there is considerable debate on the precise way one should measure the cost of capital and in what follows we shall restrict our attention to the more tractable interest rate variable.
then to be maximized. Let us further assume that this procedure yields a level of desired capital stock (desired in the future) $K^d$, given by:

$$K^d_t = B_t \cdot 0_t$$

where $0_t$ is, strictly speaking, a measure of expected output. In one sense this says very little, for $K^d_t$ and $0_t$ are merely numbers at a given point of time, and one can definitionally find a series $B_t$ such that this equation holds for all time. The substantive element in (1) comes from the dependence of $B_t$ on the economic variables in the problem, such as the cost structure of the firm. The precise functional dependence is a consequence of the maximization procedure, and the usefulness of (1) depends on the nature of this relationship, and in particular on the stability of $B_t$ over time.

The firm now compares its desired level of capital stock with the level anticipated to be on hand at the beginning of period $t$, say $K_{t-1}$ and we can let

$$\Omega_t = K^d_t - K_{t-1} = (B_t \cdot 0_t - K_t)$$

represent the gap between desired and actual capital stock. A firm which attempted to make up the entire gap would be behaving according to a strict version of the acceleration hypothesis. Recent contributions to the literature have emphasized, however, that a flexible acceleration hypothesis
which would lead firms to attempt only a partial adjustment of their capital stock is more realistic. We can thus rewrite (2) as

$$\Omega_t = b (K_t^d - K_{t-1}) = b (B_t K_t - K_t)$$

where $b$ is the speed of reaction of the firms.\(^1\)

$\Omega_t$, of course, is not an observable variable since it refers to the actual additions to the capital stock (in a productive sense) and not to the observed investment expenditures for which data are available. We noted above that additions to capital generated a future stream of expenditures, and we can formalize this by writing:

$$I_t = \sum_{i=1}^{\infty} k_i \Omega_{t-i}$$

where $I_t$ represents expenditure, and the $k_i$'s are a set of weights. In order to utilize (4), one must specify the weights exactly. The limited evidence on the point suggests that a\(^1\)

---

\(^1\) There is, strictly speaking, an inconsistency above. We referred to a maximization procedure which led to equation (1), and then we posit further costs which would lead to a departure of the firm behavior from that result. In actuality when one explicitly wrote down some profit maximizing results one would incorporate these additional costs in that procedure and derive a result analogous to (3) directly. For an example of this type of analysis see Ando [3]. There are various types of costs which might lead to a gradual adjustment. For example, an economy of scale in the production of capital, coupled with an excess capacity cost on the part of the owner of the capital, could very likely lead to a gradual increase in the capital stock on hand.
distribution consisting of a geometrically declining series of weights may be an appropriate form for the k's. Thus we write:

\[ k_t = a r^{(i-1)} \]

where \( a \) and \( r \) are constants, and hence

\[ I_t = a \sum r^{(i-1)} \Omega_{t-1} ; r I_{t-1} = a \sum r^{(i)} \Omega_{t-1} \]

and finally we have:

(5) \[ I_t = r I_{t-1} + a \Omega_{t-1} \]

which means that current investment expenditures depend on past investment expenditures as well as on the size of the capital stock gap.

Let us rewrite (5) as:

(6) \[ I_t = a \beta B_{t-1} \Omega_{t-1} - a \beta K_{t-2} + C I_{t-1} \]

Now the influence of the interest rate and other economic variables enter, in this formulation, through the capital coefficient \( B \). Strictly speaking, the speed of adjustment factor, \( \beta \), should also depend on economic conditions, but we shall treat it as constant for the present. The simplest hypothesis concerning the interest rate would make \( B \) a linear function of the interest rate, \( r \). Thus we have:

\[ [15, \text{ pp. 415-16}] \]
\[ B_t = B_1 + B_2 r_t \]

which we substitute into (6). We then combine constant terms to produce:

(7) \[ I_t = A_1 0_{t-1} + A_2 (r_{t-1} 0_{t-1}) + A_3 K_{t-2} + A_4 I_{t-1} \]

Estimation of (7) as it stands suffers from several difficulties. Firstly, several of the variables are trend dominated, and the causal interpretation of the equation becomes somewhat tenuous. Secondly, this trend property means that the independent variables will be relatively highly correlated, and this will create problems of multicollinearity. And finally, our interest rate variable enters in the equation in conjunction with another variable, and hence we have not isolated the interest effect. In order to deal with all these difficulties at once it was decided to divide through (7) by the output variable\(^1\), thus yielding:

(8) \[ \frac{I_t}{0_{t-1}} = A_1 + A_2 r_{t-1} + A_3 \frac{K_{t-2}}{0_{t-1}} + A_4 \frac{I_{t-1}}{0_{t-1}} \]

We have thus far neglected to specify the nature of the capital stock variable. The difficulty arises if the relevant

\(^1\) This of course may create certain difficulties of its own. However, the homogeneity of (7) means that no term in one over output will appear, and the fact that we are dividing through by lagged output which is predetermined will not complicate the error distribution as much as if we had divided through by an endogenous variable.
capital stock notion as a factor of production is a homogeneous physical magnitude. In this case output (via a production function), and hence investment, may bear no stable relation to the value of capital. Formally, one should treat this problem by using many heterogeneous capital goods and a programming type of analysis. We do not propose to examine fully the usefulness of an aggregate value concept. The recent literature is replete with the making of a debate on the subject. Ando, Samuelson, and Solow, while recognizing its shortcomings, have argued in favor of using an aggregated capital concept - only in certain instances to be sure. Kaldor and Robinson, on the other hand, have argued vehemently against the concept. Haavelmo, in a recent book, admits both possibilities and presents examples to illustrate this, although in all fairness, one should probably describe as more skeptical than not.

There is in the literature another approach to the problem, and that is to substitute the concept of capacity for that of capital stock. Capacity, however, like capital stock, is a concept beset with definitional arbitrariness.

---

1 See, for example, Ando [4], Samuelson [50], Solow [53], Kaldor [28], Robinson [46] and Haavelmo [25] and the numerous references cited in these sources.

2 While one can present a capital stock adjustment model or a capacity adjustment model, one should emphasize that the two are different concepts - especially in the long run. Capacity, in the sense of obtainable output, is a function of capital stock and all other factors of production. For example, if we admit labor substitutability, there will be a difference between the two principles, although it may not be very significant for short run fluctuations.
For example, capacity is often defined loosely as the flow of output per time obtainable from existing facilities. Does obtainable output refer to maximum output independent of cost (engineering capacity) or does it refer to some minimum average cost notion (economic capacity)? While economic capacity seems the more relevant of the two, problems of multiple shifts and the like probably make it a harder concept to define. There is on balance little to choose between the capital stock and the capacity notions since both, as indicated above, have their respective shortcomings. In what follows, we have, somewhat arbitrarily, decided to attempt an explanation of investment, using a function similar to (8) in which we have replaced the capital stock variable by a measure of capacity.

In particular, a measure given by \( \frac{Y_t^p}{C_t} \times Y_t \) was constructed where \( C_t \) is itself a measure of the percentage of capacity utilized which was constructed by Frank de Leeuw.\(^1\) \( Y_t \) is seasonally adjusted gross national product, and the capacity variable was actually introduced in the regressions as deviations from last quarters' output as \( Y_t^p = Y_t^p - Y_{t-1} \). Secondly, we constructed \( Y_t^\ast = \sum_{i=1}^{\infty} (Y_{t-i}/6) \) which we used to normalize the variables in (8) instead of simple lagged output. Finally, it was decided to introduce \( Y_t^\ast = Y_t - Y_t^\ast \).

\(^{1}\) It appears in [14]
where $Y^*_t$ is previous peak output. This variable, it is hoped, will capture any residual pressures on the capital stock not explicitly accounted for by the capacity variable.

In the actual regression, following a suggestion of Professor A.K. Ando, we introduced multiplicative seasonal dummy variables in order to allow for a possibly more appropriate lag pattern. With these modifications to (8) we have obtained the following results where $r_b$ is the rate on long term government bonds.

$$\frac{I_t}{Y_t} = \frac{0.018 + 0.276 S^2_{t-1}}{Y_t} + \frac{0.138 S^3_{t-1}}{Y_t} + \frac{0.240 S^4_{t-1}}{Y_t}$$

$$+ \frac{0.00127 r_b}{Y_t} + \frac{0.027 Y^*_t - 0.0019 Y^p_t}{Y_t}$$

$$R^2 = 0.942$$

All the variables have the expected signs and, except for the capacity variable, are statistically significant. Omission of that variable produced an equation in which the interest variable achieved a slightly higher degree of significance.

Namely:

$$\frac{I_t}{Y_t} = \frac{0.014 + 0.283 S^2_{t-1}}{Y_t} + \frac{0.140 S^3_{t-1}}{Y_t} + \frac{0.243 S^4_{t-1}}{Y_t}$$

$$+ \frac{0.00142 r_b}{Y_t} + \frac{0.0288 Y^*_t - 0.0019 Y^p_t}{Y_t}; R^2 = 0.942$$
Thus, the results generally appear favorable to an interest effect on investment, and we shall introduce an equation of this form into our final model.\footnote{It should be noted that the precise choice of variables introduced above is the result of some earlier work on a different body of data. However, for purposes of completeness the results shall be briefly noted here. The output series used was a private economy figure of seasonally adjusted quarterly totals at annual rates in constant 1954 dollars. As a result of this last feature, some price adjustments were made on the investment data. Finally, the interest rate used was Moody's Industrial Corporate bond yield. The results, using \( 0 \) for output and notation equivalent to above, are:

\[
\frac{I_t}{O_t} = \frac{0.0275 - 0.0327}{(0.0056)(0.0087)O_t} + \frac{0.0214}{r} + \frac{0.709}{I_t} + \frac{0.0400}{0.0084} (0_t - 0_{t-5})
\]

\[R = 0.964\]

Similar results were obtained using a linear interest rate variable and when using the sum of producers' durable equipment and other new construction (GNP accounts) as a measure of output. In particular, if \( P \) represents this latter sum, we found:

\[
\frac{P_t}{O_t} = \frac{0.0431 - 0.032}{(0.0081)(0.012)O_t} + \frac{0.054}{r} + \frac{0.577}{P_t} + \frac{0.0508}{0.0129} (0_t - 0_{t-5})
\]

\[R = 0.951\]

When this form of equation was applied to the data used in the text, we found:

\[
\frac{I_t}{Y_t} = 0.019 + \frac{0.280}{(0.017)} S^2_{t-1} + \frac{0.144}{(0.013)} S^2_{t-1} + \frac{0.275}{(0.016)} \frac{S^4_{t-1}}{Y_t} + \frac{0.639}{(0.056)} \frac{I_{t-5}}{Y_t} - \frac{0.025}{(0.007)} Y_t + \frac{0.045}{(0.008)} (Y_{t-1} - Y_{t-5}) + 0.002 \frac{1}{r} + 0.002 \frac{1}{0.008}
\]

\[R^2 = 0.933\]

The extreme cyclicity present in the residuals of this equation and the lack of a significant interest coefficient led to the introduction of \( Y_t \) and the return to a linear form of interest variable, presented in the text above.
In our discussion of fixed investment, we introduced into our model a long term Treasury bond rate to serve as a measure of the interest costs associated with the undertaking of relatively (as compared with inventory) long lived investment projects. For purposes of completeness and, more importantly, so that we can trace the ramifications of monetary policy actions on investment and income, it is necessary that we explain the long term rate. It is to this discussion that we now turn.

D. LONG TERM INTEREST RATES.

The problem of explaining the term structure of interest rates has not received extensive treatment in the academic literature, and consequently only a few theories concerning the term structure have been advanced.¹ Fisher's The Theory of Interest published in 1930 developed the relationship between short and long rates under conditions of perfect foresight, and this later became the basis for the expectational theory of the term structure. The expectational theory, as developed by Hicks and Lutz, contends that the interest rate on long term debts tends to equal the average of the short term rates expected to exist over the duration of the long term debt.² To account for the greater volatility and sensitivity observed in the short rate, this theory in-

¹ For a review of the literature see [38]
² See [27], [33]
vokes the explanation of inelastic expectations. That is, expected short rates are altered by only a fraction of the current change in short rates so that the long rate displays a smaller change. This, however, is not the only possible explanation.

We have already discussed above, in the context of bank liquidity, the factors which make short term securities more liquid than long term ones, and also the reasons for banks needing to hold liquid assets. The need for liquidity is not restricted to banks, and in fact all economic units may have to provide for liquidity. This concern of many institutions with their ability to meet possible liquidation needs is strengthened by a set of legal and customary requirements aimed at insuring adequate liquidity on the part of these institutions. The degree of liquidity provided by the stock of assets in the economy is not unrestricted, as the volumes of currency, bank deposits, and short term government securities are subject to government control.

Utilizing these observations, Culbertson has advanced a liquidity theory to explain divergent movements of long and short rates. He argues that short rates are more volatile, because the volume of outstanding private short term debt declines by a far greater proportion in a recession than does long term debt. Hence, if many investors have preferences for holding short claims, they will accept much smaller returns on
those assets which are available, and hence at the margin liquid securities will command a premium. Thus Culbertson notes:

"Abnormally low yields on liquid short-term debt during a depression may be an indication that the economy is starved for liquidity, and abnormally high yields on such debt during prosperity may indicate that the supply of liquidity is excessive for the time." ¹

This explanation has a certain amount of intuitive appeal, but unfortunately there is no adequate quarterly series of private debts by maturity category. Thus, statistical implementation of this point is untractable for the time being. It seems, however, worthy of investigation, if only because the implications of the liquidity theory for monetary policy differ in various respects from those of the expectational theory.²

Corresponding to the limited theoretical work directed towards explaining the interest rate structure, there has also been limited econometric implementation of the existing theory. Okun, however, in a recent paper has advanced a model in which he relates the level of both short and long rates to money, income, and the existing stocks of government securities of various maturities.³ Since his approach appears to suggest a promising mode of attack for our problem, we shall discuss it below.

¹ [11, p. 517]
² Culbertson [11, pp. 516-517] gives several examples of policy differences.
³ Okun [43]
A simple Keynesian model suggests that yields on government securities are related to the stock of money and to income. A quantitative explanation of interest rates in terms of the components of private balance sheets, such as the stock of money, does not provide an estimate of the way in which interest rates are affected by monetary policy. In order to achieve this, one must link the balance sheet items to variables of a policy nature. The alternative is to relate interest rates directly to variables under public control. Okun incorporates this approach into his investigation by experimenting with two potential money stock variables as well as with the actual stock of money, and in fact finds that the policy linked variables are more satisfactory in explaining the two interest rates.

With respect to inclusion of the income variable, Okun states that it is designed to reflect private transactions demand for liquidity. It is clear, of course, that this does not get at the Culbertson liquidity effect. In fact, Okun's estimates yield a larger coefficient for income in the short rate equations than in the long rate one. That is, an increase in income would narrow the differential between the two rates while the liquidity hypothesis says an increase in the demand for liquidity would widen the differential. This result is to be expected, since no measure of overall private short term debt was included in the model.
It is generally acknowledged that the maturity mix of funds demanded from all sources varies as economic conditions change. This fact, coupled with lender preferences as to maturity structure, i.e., funds are not perfectly mobile among debts of different maturities, means that the maturity structure of outstanding debt may have a significant influence on the structure of interest rates. In particular, both Federal Reserve monetary policy actions and Treasury debt management operations can alter the volume and composition of government securities which are privately held.

In this spirit Okun includes two variables $S$ and $L$, which reflect the dollar maturity value of marketable issues held outside government agencies and the Fed, separated into short and long respectively. A sample of Okun's results are presented below where $M^*$ is a potential money variable, and $T$ is the mean maturity of the outstanding long term securities, and the $q$'s are seasonal factors.

\[
\text{long rate} = -2.21 - 0.0066 M^* + 0.0219 S + 0.0187 L + 0.0105 Y + 0.0046 T
\]
\[
\text{short rate} = -1.57 - 0.0370 M^* + 0.0576 S + 0.0410 L + 0.0227 Y
\]
\[
- 0.62 Q_1 - 0.47 Q_2 - 0.21 Q_3
\]
\[
R^2 = 0.935
\]
\[
R^2 = 0.899
\]
There are several features of these equations which are open to question. For one, both the expectational theory and the liquidity theory present the determination of the interest rate structure in a consistency framework. That is, each attempts to relate the longer rates to the shorter rates in a consistent manner with respect to one or more criteria. Thus the former theory requires consistency with respect to expectations and the latter with respect to liquidity. This suggests that the short rate should be included among the determinants of the long rate.\[^1\] We have observed already in our discussion of the supply of commercial loans that it is difficult to work with two interest rates in a single regression equation, since they tend to be highly correlated and can obscure the underlying causal relations. Okun, in fact, is already working with several highly correlated variables (money, income, and interest rates all have simple correlations of .9 or better with each other), and this casts some doubts as to the interpretation and the stability of his results. In order to include the short rate in the determination of the long rate and to further avoid these additional prob-

\[^1\] It should be noted that one might interpret Okun’s results as representing reduced form equations, and this would account for the lack of a consistency framework. However, it is hard to imagine a properly specified structural system which has income for an exogenous variable and yet simultaneously determines both the long and short rates.
lems, it was decided for our purposes to attempt to explain the differential of the long rate over the short rate. Okun, in fact, mentions this differential briefly and identifies it with the degree of tightness in the financial markets. In particular, the greater sensitivity of the short rate to the degree of tightness makes the differential depend on the overall state of the financial markets. With these considerations in mind let us now turn to specification of our equation.

The dependent variable, as noted above, shall be the differential of the long term government bond rate, \( r_b \), over the bill rate. In view of the arguments already presented, we shall follow Okun and include two variables \( S \) and \( L \), which measure the stocks of short and long term, respectively, of outstanding marketable U.S. government securities. An increase (i.e., sale) in the stock of outstanding short term securities would, ceteris paribus, raise the bill rate and hence narrow the differential between the long and short rates. An increase in the stock of long term securities will, ceteris paribus, raise the long rate and increase the differential. Thus, the sign of \( S \) should be negative and that of \( L \) should be positive.

The second factor which is expected to influence the differential is a variable measuring, in some manner, the money supply. We shall actually use our \( D^* \) measure of potential money supply for this purpose. In particular, as we increase
$D_\ast$, that is $AD_\ast > 0$, we should expect an easing of monetary conditions and a consequent increase in the rate differential. Similarly, tight money conditions are associated with a decline in the potential money supply and a consequent narrowing of the differential. Thus, we expect the potential money supply variable to exhibit a positive sign. As we have done in the equation explaining the differential of the loan rate over the bill rate, we shall introduce here a second measure of tightness, namely the borrowing-net demand deposit ratio of noncountry banks. Here, however, we shall introduce the variable with a lag to account for the delay in the transmission of cyclical pressures on the banking system to the remainder of the money markets. We naturally expect this variable to exhibit a negative coefficient.

We noted above that rate changes in the Treasury bill market are an example of both direct and indirect influences on the market for long term government bonds. For example, under the expectations hypothesis, changes in the bill rate will be introduced into the calculation of averages which yield the long term rates. Under the assumption of inelastic expectations, however, changes in the short rate will cause smaller changes in the long rate. This will here narrow (for an increase in the bill rate) the rate differential. Thus, a variable measuring the first difference of the bill rate will be introduced into the regressions, and it will be expected to have a negative sign.
Finally, we will tentatively follow Okun in introducing an income variable into the equation. As noted above this is not really measuring liquidity needs as such. Changes in income are, by definition, changes in the extent of economic activity which can have several possible effects on the rate differential. For one, changes in economic activity are expected to cause changes in the same direction in the demand for loanable funds. Thus, a higher level of \( Y \) will mean a greater demand for funds (not particularly liquid ones) and a consequent narrowing of the rate differential. Secondly, changes in income will presumably influence expectations with respect to future short and long rates, although the precise chain of events by which this occurs is relatively unknown. Let us now turn directly to some single equation estimates. We first calculated:

\[
r_b - r_s = 0.093 + 0.010 S + 0.018 L - 0.118 (A r_s)_{-1} - 0.007 Y \\
&\quad + 0.093 (A D^s) - 0.037 (B^N / D^N)_{-1}; \quad R^2 = 0.593
\]

Several features of this result should be noted. First, both \( S \) and \( L \) are statistically insignificant, and in fact \( S \) has the wrong sign. Secondly, the income variable, although having the appropriate sign, contributes nothing to the explanatory power of the equation. In view of this it was decided to substitute a more specific measure of the demand for
funds in our equation. The simplest way to do this is to merely use the investment component of $Y$. In particular, we introduced the sum of fixed and inventory investment into the above equation with the following result.

\[
r_{b} - r_{s} = .728 + .009 S + .015 L - .299 (A_{r_{s}})_{-1} - .128 (I+AH)_{-1} + .073 AD^* - .034 (B^N/D^N)_{-1}; \quad R^2 = .699
\]

The added variable is clearly statistically significant and considerably improves the fit from a multiple correlation of .593 to one of .699. It should be noted, however, that $S$ retains the incorrect sign and is now even statistically significant. It was next decided to add seasonal dummy variables and a laged value of $r_b$ to the above result, and they produced the following:

\[
r_{b} - r_{s} = .728 + .027 S + .020 L - .252 (A_{r_{s}})_{-1} - .159 (I+AH)_{-1} + .075 AD^* - .024 (B^N/D^N)_{-1} + .113 S_2 + .002 S_4 - .285 S_3 - .497 (r_{b})_{-1}; \quad R^2 = .773
\]

As is clear from the above, there is a reasonable amount of seasonal variation in the rate differential which is picked up by the seasonal dummies ($R^2 = .760$ prior to the introduction of the lagged bond rate), and the fit is consequently somewhat improved. The introduction of the level of the potential money supply into this result added nothing to the
equation. It should be noted that both the S and L variables are now significant with a positive sign which is indeed puzzling. S and L, of course, are far from ideal variables, since they record changes due to certain issues crossing the dividing line between maturity categories as equivalent to changes attributable to open market operations, Treasury new issues, and maturing securities. As a result of this feature S and L tend to be highly negatively correlated (−.8 in our sample) which may partially account for the difficulty of separating out maturity effects. A second problem connected with these variables, if used in linear form, is their lack of dimensional consistency with the dependent variable. The equations state that a long run growth trend in the security variables would, ceteris paribus, lead to a steady widening of the rate differential.1 Perhaps the ratio S/L would be more appropriate to avoid this dimension problem and the multicollinearity problem as well, although this variable would also exhibit some exaggerated movements due to the arbitrary maturity division.

In addition to these technical difficulties there are several more fundamental difficulties with the above formulation,

1 This dimension problem is also present in Okun's formulation where a growth in outstanding securities would lead to a secular increase in both the short and long rates. It should be noted that this problem is not restricted to the security variables but also is associated with the use of level variables for both money and income.
and they should be briefly noted. The behavior of the interest rate structure, and in particular of the rate differential which has been our concern, is the net result of the interaction of both lender and borrower preferences. At a minimum, in considering lender behavior, one should examine the portfolio selection behavior of several economic groups who are the major holders of both government and private securities. For example, one should investigate the behavior of commercial banks, of savings and loan associations, of pension and trust funds, and of life insurance companies. In the above formulation we have made two critical simplifications. First, we have assumed that the net reactions of these various groups can be summarized by certain key variables. Secondly, we have assumed that the appropriate functional form for these variables is a linear one. Both of the assumptions are of questionable validity, and the subject clearly needs further investigation in order to determine the effects on the results of relaxing these assumptions. We shall return to this problem in the context of our two stage estimation.
CHAPTER IV
COMPLETION OF THE MODEL AND STRUCTURAL ESTIMATION

Having presented a number of single equation estimates of various aspects of the banking sector and of some related components of the overall economy, we now integrate these discussions into a single model. In particular, the last chapter investigated various elements of private demand which were connected with the monetary sector. Thus, for purposes of completeness and in order to allow for the simultaneous nature of our problem, we must now aggregate these various demand elements into total demand.

We began Chapter I by emphasizing that the supply of money can in part be regarded as a product of the banking system's liquidity decisions, and we derived under simplified assumptions an expression representing this dependence. We begin this chapter with a similar derivation performed, however, under more realistic assumptions. The second section of the chapter is devoted to a discussion of the demand for money, and in the third we present a simple national income accounting model which enables us to specify our income equation. We then turn to a specification of the complete model and to a discussion of some of the empirical difficulties encountered in the estimation of the model. We conclude the chapter with a presentation and discussion of the empirical results. We now turn to a discussion of the supply of money.
A. SUPPLY OF MONEY

In what follows we shall avail ourselves of the following notation.

\[ D : \text{Demand deposits adjusted of both member and non-member banks.} \]
\[ C : \text{Currency in the hands of the public.} \]
\[ D' : \text{Net demand deposits held at member banks.} \]
\[ D'' : \text{Net demand deposits held at nonmember banks.} \]
\[ T' : \text{Time deposits held at member banks.} \]
\[ D_E : \text{Demand deposits held by the government at member and nonmember banks.} \]
\[ R^R : \text{Required reserves of member banks.} \]
\[ R^U : \text{Unborrowed reserves of member banks.} \]
\[ R^F : \text{Free reserves of member banks.} \]
\[ k_D : \text{Average reserve requirement against net demand deposits.} \]
\[ k_T : \text{Average reserve requirement against time deposits.} \]
\[ M : \text{Stock of money, defined as currency plus demand deposits adjusted.} \]
\[ E^N : \text{Excess reserves at noncountry member banks.} \]
\[ E^C : \text{Excess reserves at country member banks.} \]
\[ B^N : \text{Borrowings at noncountry member banks.} \]
\[ B^C : \text{Borrowings at country member banks.} \]
\[ D^N : \text{Net demand deposits at noncountry member banks.} \]
\[ D^C : \text{Net demand deposits at country member banks.} \]
Using the above variables, we can write definitional equations for the stock of money, the volume of demand deposits adjusted, and required reserves, respectively. In particular, we have:

(1) \( M = C + D \)

(2) \( D = D' + D'' - g \)

(3) \( R^R = k_D \cdot D' + k_T \cdot T' \)

From (3) we can write:

\( D' = \frac{R^R}{[k_D + k_T (T'/D')] + R} \)

and combining this with the fact that \( R^R = R^U - R^F \), we can write after some simple algebra:

(4) \( D' = \frac{R^U}{[k_D + k_T (T'/D')] + R^F/D'} \)

We also have the following identities:

(5) \( D^N + D^C = D' \)

(6) \( R^F = E^N + E^C - B^N - B^C \)

In addition, we posit the following three behavioral relations where the barred quantities will, for our purposes, represent exogenous parameters. We have:

(7) \( \frac{C}{C + D} = \overline{c} \)

(8) \( \frac{D^N/(D^N + D^C)}{D'} = \overline{b} \)

(9) \( \frac{(D' + D'')}{D'} = \overline{a} \)
These three equations essentially resolve distributional issues beyond the scope of this investigation. By use of (5), (6), and (8) we can write:

\[
\frac{R}{D'} = \frac{E^N + E^C - B^N - B^C}{D^N + D^C} = \frac{E^N}{D^N} - \frac{B^N}{D^N} + (1 - \beta) \frac{E^C}{D^C} - (1 - \beta) \frac{B^C}{D^C}
\]

With (2), (4), and (9) we can write:

\[
D = \frac{-a R^U}{k_D + k_T T' (D') + \frac{R}{D'}} - Dg
\]

Substituting (10) into (11) and using (1) and (7), we can finally write:

\[
M = \frac{1}{1 - c} \left[ \frac{-a R^U}{(1 - \beta) \frac{E^N}{D^N} + (1 - \beta) \frac{E^C}{D^C} - \frac{B^N}{D^N} - (1 - \beta) \frac{B^C}{D^C}} - Dg \right]
\]

In what follows we are regarding the three barred parameters, government deposits, unborrowed reserves, the two reserve requirements, and the time-demand deposit ratio as exogenous. Hence (12) represents the supply of money as related to our four endogenous liquidity ratios. Having done this we can now turn to a discussion of the demand for money.

---

1 It should be noted that a more complete formulation of the financial sector would treat $T'/D'$ as an endogenous variable. In particular, it might depend on the yield obtainable by holding time deposits at commercial banks and on this yield considered relative to comparable yields obtainable from competing financial institutions (e.g., saving and loan associations). Both these factors in turn depend on the statutory maximum rate commercial banks can pay on time deposits. Of interest, in this light, is the recent action which raised this maximum rate.
B. DEMAND FOR MONEY.¹

The discussion will consist of three parts. We will first examine an individual economic unit's transactions demand for money. We will then briefly discuss the asset demand for money, and we shall conclude with the specification of an aggregate demand function for money.

Money, either in the form of cash or as checks written on a demand deposit account at a commercial bank, retain among all assets the unique characteristic of serving as a generalized means of payment in economic transactions. Individual economic units are typically faced with a lack of synchronization between payments and receipts. Hence, at first glance it seems reasonable to assume that these economic units will choose to hold some of their assets in the form of money in order to facilitate meeting their payment commitments. In general, however, an economic unit can predict with fair accuracy its future net income stream.²

¹The discussion of this section draws heavily on Teigen, [54], who in turn made extensive use of some of the ideas of Tobin. See, for example, [55] and [56].

²Patinkin in fact refers to the transactions motive as resulting from certain but imperfectly synchronized payment and receipt streams. The precautionary motive is the result of the uncertainty of the timing of these payments and is introduced in his model by imposing social opprobrium on economic units who default in their payments. For a more detailed discussion of this point, see [45, Chapt. VII].
This fact, coupled with the existence of almost perfectly liquid, riskless, income earning assets (e.g., time deposits or short term government securities), makes it feasible to invest transactions balances in one of these assets when surplus balances exist and to instantly convert back to money when needed.

Thus it appears that we have concluded that money per se is not required to be held except at the precise transaction's instant. The assumption, of course, which enables us to draw this conclusion, is that movements in and out of our liquid income earning asset are costless. In a more realistic setting, however, there will be brokerage charges, bank service charges, and the like. The existence of these costs suggest there is an economic tradeoff between holding yieldless cash on the one hand and holding an income earning asset for which there is an associated sale service charge on the other. We now turn briefly to this economic tradeoff and an investigation of the optimal cash holdings implied by it.  

1 In the U.S., for example, the holder of time deposits is not formally entitled to withdraw funds without first giving the bank thirty days' notice. Banks seldom exercise their right to such notice although they might demand notification if the frequency of transaction on an account were to become excessive. Secondly, it is only recently that the practice of giving "instant interest" has gained some prominence. However, most banks continue to compute time deposit yields on the basis of the minimum balance per accounting period. Under both these procedures, especially if the accounting period is extensive, one would expect that the movements in and out of time deposits will be lessened. Similar remarks apply also to deposits held at mutual savings banks.
Tobin has dealt with this investment decision problem quite thoroughly in the sources noted above. In these he has derived expressions for an individual's average holdings of what he terms bonds (the riskless interest yielding alternative to cash) and the revenue and total profit from such holdings. He has done so, however, on the assumption that the income payment is received at the start of the period and is paid out evenly throughout the period. Modigliani and Ando have extended this discussion to the case of income being received in instalments over the year, and it is from this generalization that we shall derive a function expressing the individual's demand for money.

The actual derivation will not be reproduced here although we shall state the assumptions and conclusions below.¹ In particular, we assume an individual to receive an income of Y per year which is paid to him in f equal installments and hence \( y = \frac{Y}{f} \) is the income received at the beginning of each decision period. Let \( r \) (\% per annum) represent the rate of interest on bonds and hence the effective rate for decision over the period is \( \frac{r}{f} \). We further posit a fixed charge \( a \) for each transaction into and out of bonds.² Under these assumptions it can be shown that the following represents the optimal cash holding during the decision period:

1. [54, pp. 114 - 117] contains the derivation
2. It is quite simple to incorporate variable charges into the analysis. See [54].
Thus if the frequency of payment is high or annual income is low or if $r$ is small relative to $a$, it may not be profitable to hold bonds at all. When it does become profitable, (ii) applies. Before proceeding to the derivation of an aggregate demand for money equation, we shall briefly discuss the role of liquidity preference in the formulation of the demand for money.

According to the Keynesian liquidity preference doctrine, when a rise in the interest rate (a decline in the price of bonds) is expected, individuals holding bonds will shift out of them and into money. Thus money is assumed to be demanded as a portfolio asset, and consequently the stock of money net of transactions requirements will vary inversely with the interest rate.

This conclusion is valid only if there is no asset which dominates (i.e., equivalent in all respects and superior in at least one) money. Time deposits, as we have noted above, are a liquid riskless asset which provide a positive return and hence dominate money as a store of value. Thus, given the existence of an asset or assets which dominate money as a means of holding wealth we conclude that the asset demand for money will not exist in a
rational economy.¹

The result of the above sections was to discuss the individual's transactions demand for cash balances and to assert that the asset demand for money balances has no rational justification. The rules (i), (ii), presented above express the optimal average cash balances of profit maximizing individuals, and we are now faced with the problem of deriving an adequate macroeconomic relationship from these rules.

We shall proceed by making a set of successive approximations which will adapt the rules into a macroeconomic formulation suitable for estimation. We first note that aggregation of individual demands will necessarily comprise summing individuals who are following different rules. In addition, in a more realistic setting we cannot expect to satisfy exactly the assumptions implicit in the derivation of these rules. We shall therefore rewrite the individual's demand for money as

\[ C_i = \Omega \circ \alpha_1 y_i \alpha_2 \]

¹ It should be noted that the "broker's charge" for moving in and out of time deposits may be sufficiently large relative to the return on these assets to justify occasional accumulations of cash in the permanent portfolio. Thus, if transactions on capital account are expected to occur in the near future, the analysis outlined above may apply. See, on this, Tobin [56, Chapter 4, pp. 23-25]
in which we have subsumed both \( f \) and \( a \) as institutionally determined constants. Ignoring the aggregation problem, we write the following approximation:

\[
(iii) \quad \Sigma C_1 = M \approx \gamma_0 r^1 y^2
\]

We shall now rewrite this function by assuming the demand for money can be written as the product of a function of \( r \) and a function of \( Y \). In particular, holding \( Y \) constant, we can obtain a relationship between \( M \) and \( r \) by expanding \((iii)\) in a Taylor series and truncating the higher order terms. This yields:

\[
f(r|y) \approx r_o^{\gamma_1} + r_0^{\gamma_1 - 1} (r-r_0) = d + B_1 r
\]

In addition, in the aggregate there is some evidence that the relationship between the income velocity of money and the interest rate is approximately linear over a fairly wide range. At a given interest rate this would imply a constant velocity and a proportional relationship between \( M \) and \( Y \), which we can write as \( M = B_2 Y \) where \( r \) is held constant.\(^1\) Multiplying the two segments of the monetary demand schedule, we have:

\[
(13) \quad M = (d+B_1 r)(B_2 Y) = \gamma_1 Y + \gamma_2 (rY)
\]

---

\(^1\) Teigen, [54, p. 121-24], has a detailed explanation of this step which we shall not reproduce. For some evidence on the wide range of linearity see [29].
As the empirical satisfactoriness of this form of money demand function is relatively well established, no single equation estimates were performed. When we turn to estimating our entire system, we shall modify (13) with dummy variables to account for seasonal variation, and, in addition, a lagged value of the dependent variable will be included to test for the existence of a geometrically decaying distributed lag. Having discussed the supply and demand for money, we now set forth the remainder of the model. We shall first present a simple Keynesian income determination model which will form a component of our larger model.\(^1\)

C. NATIONAL INCOME ACCOUNTING.

In what follows we shall make use of the following variables:

- \(Y\) : Gross national product.
- \(Y_d\) : Disposable Income
- \(C\) : Private consumption expenditures.
- \(I_p\) : Gross private domestic investment.
- \(I\) : Business plant and equipment investment.
- \(H\) : Stock of manufacturers' inventory.
- \(Ex\) : Exports of goods and services.
- \(Im\) : Imports of goods and services.

\(^1\) This model is adapted from one presented in [54]
G : Government purchases of goods and services.

Tx : Total taxes.

Tr : Government transfer payments.

D : Depreciation allowances.

CP : Undistributed corporate profits.

SI : Total social insurance contributions.

IV : Inventory valuation adjustment.

NW : Net worth.

In what follows we take as exogenous exports of goods and services, government expenditures, and certain components of private domestic investment. In particular, we will later endogenously explain both manufacturers' inventory investment and business investment in plant and equipment. The consumption function takes its form from the Modigliani-Brumberg-Ando formulation which makes consumption a function of net worth and disposable income. The remainder of the model is set forth below where for notational simplicity we have omitted the constant terms.

\[ Y = C + I_P + (Ex-Im) + G \]

\[ C = B_1 Y_d + B_2 NW \]

\[ Y_d = Y - Tx + Tr - D - CP - SI - IV \]

\[ Tx = B_3 Y \]

\[ Tr = B_4 Y \]

\[ D = B_5 NW \]

\[ CP = B_6 Y - B_7 Y_{t-1} \]

---

1 See [5] and references cited there.
Simple algebra yields

\[ C = B_1 (Y - B_3 Y + B_4 Y - B_5 \cdot NW - B_6 Y + B_7 Y_{t-1} - B_8 Y - B_9 H) + B_2 NW \]

\[ Y = YB_1 \left[ (1 - B_3 + B_4 - B_6 - B_8) + (B_2 - B_1 B_5) NW + B_1 B_7 Y_{t-1} + E + I + AH - B_1 B_9 H - B_1 0 Y \right] \]

\[ Y = \frac{(E + I + AH)}{[1 - B_1 (1 - B_3 + B_4 - B_6 - B_8) + B_1 0]} + \frac{(B_2 - B_1 B_5) NW}{[1 - B_1 (1 - B_3 + B_4 - B_6 - B_8) + B_1 0]} \]

\[ + \frac{B_1 B_7 Y_{t-1}}{[1 - B_1 (1 - B_3 + B_4 - B_6 - B_8) + B_1 0]} - \frac{B_1 B_9 H}{[1 - B_1 (1 - B_3 + B_4 - B_6 - B_8) + B_1 0]} + \eta \]

Thus, we have expressed income as a function of net worth, lagged income, the stock of inventories, exogenous expenditures, and an endogenous investment category. When we actually implement this expression statistically, we shall further add seasonal dummy variables into this equation. Having derived an expression for an income equation, we can now turn to a presentation of the model in its entirety.
D. SPECIFICATION OF THE MODEL

Before specifying the complete model, it will help the reader to present a list of the variables as yet undefined in this chapter (although used in earlier ones).

\[ r_s \] : Rate on three month Treasury bills.
\[ r_d \] : Federal Reserve discount rate.
\[ r_e \] : Rate charged on commercial and industrial loans.
\[ r_b \] : Rate on long term Treasury bonds.
\[ S^N \] : Stock of short term securities held by non-country member banks.
\[ 0^N \] : Stock of long term securities held by non-country member banks.
\[ S^C \] : Stock of short term securities held by country member banks.
\[ 0^C \] : Stock of long term securities held by country member banks.
\[ C_L \] : Volume of commercial and industrial loans outstanding, held by all member banks.
\[ S_H \] : Volume of privately held marketable short term U.S. government securities.
\[ L_O \] : Volume of privately held marketable long term U.S. government securities.
\[ D^* \] : Potential deposits of the banking system.
\[ S \] : Manufacturers' sales.
\[ U \] : Manufacturers' unfilled orders.
\[ Y^P \] : Potential gross national product.
\[ Y^* \] : Previous peak gross national product.
\[ \bar{Y} \] : Gross national product averaged over the previous eight quarters.
We can now set forth at this time our entire model in functional form. Since the final form of the model depends on the results of the statistical experimentation to be discussed below, we shall avail ourselves of a limited amount of hindsight in the specification of the complete system.

(15.1) \[ Y = f(E, I + AH, Y_{-1}, S_2Y_{-1}, S_3Y_{-1}, S_4Y_{-1}) \]

(15.2) \[ M = f(r_s, Y_{-1}, S_2, S_3, S_4) \]

(15.3) \[ M = f \left( \frac{E}{D}, \frac{E^C}{D^C}, \frac{B^N}{D^N}, \frac{B^C}{D^C} \right) \]

(15.4) \[ \frac{E^N}{D^N} = f(r_s, B^N/D^N, S^N/D^N, \lambda(S^N/D^N), d_1) \]

(15.5) \[ \frac{E^C}{D^C} = f(r_s, B^C/D^C, D^C, \lambda(D^C), d_1, S_2, S_3, S_4) \]

(15.6) \[ \frac{B^N}{D^N} = f(r_s, E^N/D^N, D^N, (B^N/D^N)_{-1}, d_5) \]

(15.7) \[ \frac{B^C}{D^C} = f(r_s, E^C/D^C, D^C, (B^C/D^C)_{-1}, d_5, S_2, S_3, S_4) \]

(15.8) \[ \frac{S^N}{D^N} = f(0^N/D^N, D^N, r_e, (S^N/D^N)_{-1}, S_2, S_3, S_4) \]

(15.9) \[ \frac{S^C}{D^C} = f(0^C/D^C, D^C, r_e(S^C/D^C)_{-1}, S_2, S_3, S_4) \]

(15.10) \[ A CL = f(AH, AY, r_e, r_s, S_2, S_3, S_4) \]

(15.11) \[ r_e - r_s = f(A(0^N/D^N), B^N/D^N, (Ar_s)_{-1}, AD^*, D^*) \]

(15.12) \[ I/Y = f(Y_{-1}/Y_1, Y_{-1}/Y_1, (r_b)_{-1}, S_2I_{-1}/Y_1, S_3I_{-1}/Y_1, S_4I_{-1}/Y_1, I_{-1}/Y) \]
These fifteen equations form a simultaneous set of equations in the following fifteen unknowns: \( Y, M, E^N/D^N, E^C/D^C, B^N/D^N, B^C/D^C, S^N/D^N, S^C/D^C, CL, r_e, r_s, r_b, H, I, S \), and we thus have a determinate system.

Before presenting the results of the estimation, several comments are in order. First, it should be noted that our system contains various nonlinearities. Nonlinearities which are the result of normalizing each bank asset by the appropriate net demand deposit quantity do not present much difficulty. This is so since these variables never appear in unnormalized form, and if they were the only nonlinearities present, one might regard the system as essentially linear.

There is, however, another more inherent type of nonlinearity present in the system. In particular, the supply of money represented by (15.3) is a nonlinear function of these (non-linear) variables, and the demand for money (15.2) also contains a nonlinear function of two endogenous variables.

Strictly speaking, the properties which two stage least squares are known to possess and the standard identification
criteria apply only to linear models. Since the precise properties of the estimates we shall present are unknown, we shall compromise and assume these properties are similar to those possessed by two stage least squares estimates of linear systems. We shall further compromise in stating that the usual identification conditions applied to our system (viewed as linear) imply that each of our equations is over-identified.

A final set of problems with respect to the actual estimation are created by the presence of nonlinearities. In particular, whenever a nonlinear function of an endogenous variable appeared as an explanatory variable (e.g., \( r_s Y \)), it was introduced in the first stage as a separate variable in order that it might be corrected for inclusion in the second stage. Furthermore, certain exogenous variables which appeared as part of a ratio but never appeared alone (such as net demand deposits) were arbitrarily excluded from the first stage. Limited investigation suggested that the results would not be significantly changed by their inclusion. Finally, it was decided to omit the two sets of multiplicative seasonal dummy variables in the first stage and simply include the additive variables in order to avoid problems of multicollinearity.

The selection of a subset of all the exogenous variables for inclusion in the first stage is also common practice when the number of exogenous variables exceeds the number of observations. Principal components can also be used to get around this difficulty.

For an example of necessary and sufficient conditions for identification of certain types of nonlinear structural equations see [21 A].
Before turning to the empirical results, several general comments are in order. For each individual equation the functional form chosen for initial estimation was the one conforming most closely to both the single equation estimates presented above and to our a priori reasoning. When the initial structural estimates were unsatisfactory or when there were certain aspects of the structure which were not settled, we then performed additional experiments with each individual equation. However, the two stage least squares procedure we shall use in estimating our system creates certain difficulties with respect to performing these experiments. Since in the first stage we regress each endogenous variable on all of the exogenous variables, the structural estimate of any individual equation depends on the specification of the entire system. In particular, introducing a new exogenous variable into one equation technically requires reestimation of all other equations. However, in practice when working with a large number of exogenous variables, the addition of another one is unlikely to produce appreciable changes in any of the first stage estimates and consequently in the structural estimates.

In general, this problem did not arise since when it was decided to modify an equation, it was typically with a variable that had appeared elsewhere in the system. There were a few exceptions to this, but in light of the above we did not reestimate all the other equations during each phase of our experimentation with a given equation. However, before
presenting our final structural estimates, we reestimated the entire model in the light of these experiments, and in fact found that the estimates changed very little, if at all. We now turn directly to a presentation of the empirical results.

E. EMPIRICAL RESULTS.

1. Excess Reserves:

The first estimates calculated used a functional form which was identical with the one presented in our single equation estimates. In particular, we found:

\[
(16.1) \quad EN/DN = 3.19 - 0.347 r_s - 0.071 B^{N/DN} - 0.0075 \text{S}^{N/DN} \\
\quad \quad \quad + 0.016 (S^{N/DN}) + 2.309 d_1 ; \quad R^2 = .717
\]

\[
(16.2) \quad EC/DC = 18.98 - 2.233 r_s - 0.139 B^{C/DC} + 0.004 S^{C/DC} \\
\quad \quad \quad + 0.013 (S^{C/DC}) + 3.281 d_1 ; \quad R^2 = .698
\]

Since we did not introduce any seasonal dummy variables into these equations when we were performing single equation estimates, we did so now with the following results:

\[
(16.3) \quad EN/DN = 3.32 - 0.353 r_s - 0.073 B^{N/DN} - 0.008 S^{N/DN} \\
\quad \quad \quad + 0.0175 (S^{N/DN}) + 2.317 d_1 - 0.061 S_2 \\
\quad \quad \quad - 0.378 S_3 + 0.127 S_4 ; \quad R^2 = .719
\]
\[ (16.4) \frac{E^C}{D^C} = 19.32 - 2.752 r_s + .025 \frac{B^C}{D^C} - .005 \frac{S^C}{D^C} \]
\[ \times 0.0008 A(S^C/D^C) + 3.081 d_1 + .041 S_2 + 2.304 S_3 \]
\[ + 2.732 S_4; \overline{R}^2 = .805 \]

As is clear from the above, seasonal variation is not present in the noncountry holdings of excess reserves although it contributes significantly to the explanation of country bank holdings. While the noncountry equation behaves according to expectation, the country equation has three insignificant variables in \( B^C/D^C, S^C/D^C \), and \( A(S^C/D^C) \), and two of the three have a sign which is in disagreement with our expectations. It will be recalled that our preliminary specifications of the excess reserve equations identified the short term security position with open market operations. In view of the fact that the country banks' short term security position does not aid in explaining excess reserves, it was decided to introduce our open market measures \( D^*/D^C \) and \( A(D^*/D^C) \) into the country equation, and they produced the following result:

\[ (16.5) \frac{E^C}{D^C} = 47.51 - 2.096 r_s + 2.868 d_1 + 1.323 S_2 \]
\[ \times 0.354 + 0.510 + 0.690 \]
\[ + 2.932 S_3 + 3.291 S_4 - 5.747 D^*/D^C \]
\[ \times 0.739 + 0.849 + 1.777 \]
\[ + 5.932 A(D^*/D^C) - 0.441 \frac{B^C}{D^C}; \overline{R}^2 = .852 \]
\[ (2.628) \]
Introduction of these two variables had several noticeable effects on this equation. First, both variables are statistically significant. Second, the borrowing-demand deposit ratio is now significant for the first time with the appropriate sign, and finally the percentage of variation explained is increased somewhat. Although the sum of the coefficients of the two new variables is positive, the coefficient on $D^*/D^C$ is negative. Thus, while an increase in $D^*$, which is equivalent to an injection of reserves into the banking system, will produce the expected net increase in holdings of excess reserves, this latter increase may not be very large. 1

The introduction of the corresponding noncountry variables into that sector's equation, however, produced little of interest. Both variables, somewhat surprisingly, yielded insignificant coefficients and added nothing to the explanatory power of the equation. In the light of these experiments we shall accept a somewhat asymmetric set of equations for explaining country and noncountry bank holdings of excess reserves. In particular, (16.1) and (16.5) will be reestimated in our final model. We shall have more to say about country and noncountry comparisons at a later point.

1 This small increase in holdings of excess reserves is consistent with our finding that banks will, at least temporarily, choose to buy short term securities when supplied with an appreciable increase in reserves.
2. Borrowings:

Following our single equation estimates, we reestimated the same functional forms. It will be recalled that the seasonal dummy variables did not contribute significantly to the noncountry bank equation. They were introduced several times in the two stage estimation, and their inappropriateness was further affirmed. Thus, we have omitted these variables from the estimates presented below. For the ratio measure of relative cost we found:

\[(17.1) \frac{B^N}{D^N} = 38.70 - 5.123 \frac{r_d}{r_s} - 1.853 \frac{E^N}{D^N} - 9.263 \frac{D^*}{D^N} (1.449) (0.415) (2.096) \]
\[+ .3911 (\frac{B^N}{D^N})_{-1} + 5.789 d_5 ; R^2 = .754 \]
\[\text{(.0850)} (1.821) \]

\[(17.2) \frac{B^C}{D^C} = 22.04 - 1.058 \frac{r_d}{r_s} - 1.488 \frac{E^C}{D^C} - 3.368 \frac{D^*}{D^C} (1.569) (0.061) (1.135) \]
\[+ .480 (\frac{B^C}{D^C})_{-1} + 2.426 d_5 + 1.128 s_2 - .654 s_3 (0.0997) (0.614) (0.324) (0.345) \]
\[+ .067 s_4 ; R^2 = .817 \]
\[\text{(.360)} \]

The linear relative cost differential produced the following:

\[(17.3) \frac{B^N}{D^N} = 28.37 - 3.416 (r_d - r_s) - 1.751 \frac{E^N}{D^N} - 7.541 \frac{D^*}{D^N} (1.287) (0.446) (2.318) \]
\[+ .4277 (\frac{B^N}{D^N})_{-1} + 6.131 d_5 ; R^2 = .726. \]
\[\text{(.0886)} (1.912) \]
Both sets of equations support the existence of a relative
cost effect on bank borrowings. They also yield appropriately
signed significant coefficients for all the other variables
we have introduced. The two stage estimates, however, remain
unclear with respect to the most appropriate form of the
cost term. (17.1) fits slightly better than (17.3) although
(17.2) is slightly inferior to (17.4). Goodness of fit cri-
teria aside, the two sets of equations imply quite different
elasticities with respect to relative costs. For example,
if the bill rate rises from 3% to 4% with the discount rate
remaining the same; (17.3) says the increase in the borrowing
net demand deposit ratio will be 3.436 while (17.1) says
it will be 5.123 - (3/4) 5.123 which is 1.281. The former
figure appears much more in line with noncountry banking
behavior in the postwar period. Similar calculations per-
formed for the country equations indicate that the linear
form also yields a more realistic prediction for that sector.
As a result of these considerations, we will choose (17.3)
and (17.4) as our two borrowing equations.
3. Short term securities:

Again following our single equation estimates, we have computed the following structural estimates:

\[(18.1) \frac{S}{D} = 160.36 + 17.45 S_2 + 22.838 S_3 + 28.450 S_4 + 0.471 \frac{O}{D} + 99.764 \frac{D^*}{D} + 0.50 \times (0.098) \]

\[\text{R}^2 = 0.745 \]

\[(18.2) \frac{S^C}{D^C} = 371.89 + 4.890 S_2 + 23.262 S_3 + 18.645 S_4 - 0.756 \frac{O^C}{D^C} + 69.062 \frac{D^*}{D^C} + 0.354 \times (0.100) \]

\[\text{R}^2 = 0.838 \]

The elasticities, calculated at the means, with respect to the long term security variables are -2.7 and -4.1 for the noncountry and country equations, respectively. These elasticities must be interpreted cautiously, since they are only partial elasticities, and (18.1) and (18.2) are multivariate relations. The coefficients, however, indicate that if the noncountry banks sell one million dollars worth of long term bonds, they will use roughly half the proceeds to add to their stock of short term securities, and the other half, perhaps, will find its way to the commercial and industrial and other loan markets.

As we did in our single equation estimates, we added the differential of the loan rate over the bill rate to our equations. The coefficient of this differential was statistically significant in the noncountry equation, but its sign was counter to our expectations. In the country equation the
variable yielded an appropriate sign but was not statistically
significant. After some consideration it was decided to omit
this variable from the equations. Finally, as we have done in
other instances, we introduced $A(D^*/D^N)$ and $A(D^*/D^C)$ to the
two equations, respectively, with the following results:

\[
S^N/D^N = 149.77 + 24.043 S_2 + 29.041 S_3 + 38.628 S_4 - 4.39 O^N/D^N
\]
\[
+ 0.628(S^N/D^N)^{-1} - 52.756 D^*/D^N + 89.644 D^*/D^N^2
\]
\[
+ 66.046 A(D^*/D^N) ; R^2 = 0.748
\]

Although appropriately signed, the new variable is statistically
insignificant. Similar results were obtained for the country
sector, but they are not reproduced here. On balance (18.1)
and (18.2), which make short term security holdings depend
on seasonal factors, open market operations, the cost of
alternative investments, and the partial offset to liquidity
needs provided by the sale of long term securities, appear to
be the best explanation of the demand for short term securities.

4. Commercial Loan Market

In keeping with our earlier discussion of the demand for
commercial and industrial loans, we estimated a function
which made the demand depend on inventory investment, changes
in income, a measure of relative cost of alternative methods
of financing and seasonal factors. Structural estimation of this equation using the differential of the loan rate over the commercial paper rate as a measure of relative cost yielded:

\[(19.1) \Delta CL = 0.018 + 0.343 S_2 + 0.630 S_3 + 0.980 S_4 (0.230) (0.242) (0.222) + 0.00024 \Delta H_t + 0.0587 \Delta Y - 0.3145 (r - r_c); R^2 = 0.640 (0.015) (0.1963)\]

In order to avoid introducing a new rate variable into the model, we replaced the commercial paper rate with the bill rate and reran the regression producing:

\[(19.2) \Delta CL = 0.225 + 0.366 S_2 + 0.614 S_3 + 0.922 S_4 + 0.00026 \Delta H_t (0.227) (0.242) (0.223) (0.00010) + 0.052 \Delta Y - 0.301 (r - r_c); R^2 = 0.643 (0.015) (0.176)\]

These results seem to indicate that it does not make very much difference whether one uses the bill rate or the commercial paper rate in this context. We further experimented by introducing the level of the loan rate into this equation, but it produced no significant change in the equation.

Equation (19.2) states that a billion dollar increase in inventory investment leads to a quarter of a billion dollar increase in the demand for commercial loans. Similarly, (19.2) says a ten billion dollar increase in terms of seasonally adjusted annual rates for gross national product will produce an increase of about one half a billion dollars...
in the demand for commercial loans. Both these figures seem reasonable in the light of postwar behavior of the economy, and hence (19.2) appears to be a reasonable representation of the demand for commercial loans. In terms of the percentage of variation explained, there is certainly room for additional explanatory variables. For example, a measure of the corporate cash position either purely from the asset side or in conjunction with liabilities as in the Quick Ratio might be tried. Some early single equation estimates on a slightly different body of data indicated, however, that these particular variables would not aid significantly in explaining the demand for commercial loans.

Following our earlier discussion of the supply of commercial and industrial loans, we estimated:

\[
19.3 \quad r_e - r_s = 1.558 + 9.393 A(0^N/D^N) - 0.0456 B^N/D^N - 0.311(\Delta r_s)_{-1} \\
+ 0.0573 AD^* + 0.0048 D^*; \bar{R}^2 = 0.736 
\]

It was decided that this equation was a satisfactory representation of the supply mechanism, and no further experimentation was performed. (19.3) explicitly allows for the effects of open market operations on the rate differential via our potential money supply measure and also makes the differential depend on certain components of the banks' portfolios. In particular, by incorporating a rough measure
of bank lending capacity, we have attempted to capture the pressure created on the loan rate by new loan demand, and by including the borrowing-net demand deposit ratio and a lagged value of the first difference of the bill rate, we have tried to account for various cyclical pressures on the rate differential. We now turn to a discussion of inventory investment.

5. **Inventory Investment.**

Before proceeding to present our structural inventory estimates, we should note that we have not as yet said anything about the sales variable appearing as an endogenous variable in the inventory equation. It was decided that a serious investigation of the determinants of manufacturers' sales was beyond the scope of this investigation. In view of this it was decided to simply relate sales to some broad economic magnitude likely to reflect general demand conditions. In particular, we made sales a function of gross national product, changes in gross national product, and the seasonal dummy variables. We found:

\[
S_t = 12.65 + 0.616 Y_t + 0.230 AY - 2.097 S_2 - 3.614 S_3 \\
- 6.378 S_4; \bar{R}^2 = 0.969
\]

This result, while far from a causal relation, will suffice
for our purposes.¹

We now turn to our inventory equation estimates. Following our single equation experiments, we first estimated:

\[ \Delta H_t = -629.40 - 341.814 S_t - 565.061 S_2 + 753.787 S_3 + 150.047 S_4 + 150.047 S_t + 197.602 H_{t-1} + 132.852 \Delta U_{t-1} + .1967 \Delta H_{t-1}; R^2 = .839 \]

\[ (20.2) \]

\[ (278.150) (227.670) (290.539) (28.237) \]

As had been the case with single equation estimates, however, the introduction of several monetary measures into this equation produced unsatisfactory results. We tried the potential deposit variable and the loan rate both in level and first difference form. The experiments never produced a significant coefficient for a monetary variable save for a marginally significant (but positive!) coefficient for the level of the loan rate in one equation. We can not help feeling, however, that the high intercorrelations between the sales, interest, and lagged inventory variables may have obscured an interest

¹ Even a more refined specification of this equation would be unlikely to introduce any changes into the rest of the model. We noted above that specification of this equation could cause changes in the structural estimates only to the extent that it introduced new exogenous variables into the system. However, as also remarked above, at the margin, a new exogenous variable is unlikely to produce any appreciable changes. This both a virtue and a defect of the two stage least squares procedure we are using.
effect. One alternative would be to normalize by sales (as was done with output for fixed investment) to remove this problem. Lack of time, however, prevented this from being done, and hence we must settle, temporarily at least, for (20.2) above.

6. Long Term Bond Rate.  

We first estimated a structural equation in keeping with our earlier discussion but omitting the variables measuring the supplies of short and long term securities in private hands. We found:

\[(21.1) r_b-r_s = 1.64 - .147 (I+AH) - .051 (B^N/D^N)_1 - .321 \Delta r_s + .0051 D* + .043 \Delta D*; \bar{R}^2 = .705\]

We next introduced a lagged value of the bond rate which led to:

\[(21.2) r_b-r_s = .893 - .123 (I+AH) - .044 (B^N/D^N)_1 - .409 \Delta r_s + .0169 D* + .028 \Delta D* - .483 (r_b)_1; \bar{R}^2 = .741\]

1 The multicollinearity problem we are experiencing above can often have significant computational consequences. High intercorrelations can lead to estimates that have an unsatisfactorily low degree of precision. This arises from a nearly singular moment matrix by leading to the loss of significant digits in the inversion process. Furthermore, if some of the variables are observed with errors an additional degree of unpredictability is added to the results.

2 We have omitted presenting any estimates for fixed investment, for it will be recalled that our investment equation was specified to be a function of all lagged variables, and hence its structural estimate is identical with its single equation estimate.
Thus, a lagged value of the bond rate appears to be of use in explaining the differential between the bond and bill rates. The negative sign comes about because when bond rates are high, monetary conditions are relatively tight, and the rate differential is likely to be small. Or put another way, a rise in the long rate is likely to be accompanied by a greater rise in the short rate which will narrow the differential between them. In view of our single equation estimates it was decided to introduce seasonal dummy variables and security stock variables into (21.2). When this was done, however, D* had an insignificant coefficient, and hence the results presented below omit that variable.

\[
(21.3) \quad r_b - r_s = 0.759 + 0.028(SH) + 0.020(L0) - 0.248(\Delta r_s) - 0.163(I + AH) \\
\quad \quad \quad + 0.072 \Delta D^* - 0.024(B^{N/D^N}) - 1 + 0.116 S_2 - 0.285 S_3 + 0.010 S_4 \\
\quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quen
SH in his bill rate equation, which would seem to auger a negative coefficient above. In a final effort to salvage the relative security effect, it was decided to substitute the corresponding security flow variables in (21.3) and this produces:

\[(21.4) \quad r_b - r_s = 0.771 + 0.1457 \Delta D - 0.039 (B^N/D^N)_1 - 0.348 \Delta r_s - 0.164 (I+AH) + 0.067 S + 0.216 S_1 + 0.027 \Delta SH\]

\[+ (0.0293) \quad (0.111) \quad (0.123) \quad (0.029) \quad (0.118) \quad (0.156) \quad (0.164) \quad (0.021)\]

The flow variable, \(\Delta SH\), now has the appropriate sign although it is statistically insignificant but \(\Delta LO\) also has a negative coefficient. It should be remarked, however, that the a priori case for a positive coefficient for \(\Delta LO\) is not a very strong one, since open market sales in the long end of the market may very well be transmitted to the short end quite rapidly and produce a bigger change in the bill rate than in the bond rate. This uncertainty, in fact, manifests itself in Okun's study where he finds in several sets of regressions that the coefficients of \(LO\) in the bill and bond equations bear no stable relationship to each other in terms of relative size.

Upon closer examination of the simple correlation matrix associated with (21.4) and of the several steps in the step-wise regression, it was decided that we were encountering
multicollinearity problems with this formulation. The simple correlation between the flow security variables was about -.8, and the correlation between \((r_b)_1\) and \(D^*\) was about .9, and only when the last two variables were introduced, did the flow variables exhibit any appreciable magnitude. In view of this apparent instability of the coefficient estimates, it was decided to accept a somewhat simpler framework and to truncate the regression prior to the introduction of the last four variables. In addition, it was noticed that \(S_4\) exhibited a trivial coefficient, and that its introduction caused no changes in the other parameter estimates. As a result we omitted it in the equation presented below, which we shall adopt as our final form for explaining this rate differential.

\[
(21.5) \quad r_b - r_s = 2.24 + .0735 \Delta D^* - .0536 \left(\frac{B^N}{D^N}\right)_1 - .225 \Delta r_s \\
\quad (-.0285) \quad (-.0100) \quad (-.103) \\
\quad -.119 (I + \Delta H) + .204 S_2 - .148 S_3 ; \quad R^2 = .713 \\
\quad (-.028) \quad (-.106) \quad (-.116)
\]

(21.5) allows for the effects of open market operation on the rate differential as well as for other seasonal and cyclical pressures on the differential. For purposes of discussion it will be satisfactory although it should be noted that prior to any attempt to simulate the model, one should explore this relationship somewhat further. In particular, an investigation of the rate structure along the lines suggested above will be the subject of a future paper by the author.\(^1\) We now turn to the demand for money.

\(^1\) See Chapter III, Section D above.
7. Demand for Money.

Having completed presentation of structural estimates for equations which had single equation counterparts, we now turn to the two remaining equations, namely the demand for money and our income equation. Following our discussion of the demand for money above, we first estimated:

\[
M = 87.74 - 0.0016(rY) + 0.4496Y - 1.570S_2 - 1.711S_3 \\
+ 1.127S_4; \bar{R}^2 = 0.889
\]

There are several undesirable features about this equation. Firstly, none of the seasonal variables is statistically significant, and secondly, and more importantly, the interest effect, while exhibiting the correct a priori sign, is also insignificant. The introduction of a lagged value of the dependent variable to account for a distributed lag produced several marked changes. In particular, we have:

\[
M = 1.706 - 0.0059(rY) + 0.0471Y + 4.588S_2 + 5.427S_3 \\
+ 9.469S_4 + 0.929M_{-1}; \bar{R}^2 = 0.990
\]

The coefficient of the lagged money stock is quite large in numerical terms and is many times its standard error. Several other changes are also apparent in the equation. For one, the coefficient of the interest variable rose (in absolute

\[1\text{ It has been suggested that multiplicative seasonals would be somewhat move appropriate in (22.2).}\]
terms) considerably, and its standard error declined so that it is now about three times its standard error. Secondly, the seasonals are all significant, and they indicate that the demand for money will increase gradually over the year from seasonal factors, and will rise sharply in the fourth quarter, which is in accord with our expectations. Finally, there is the fact that the coefficient of the income variable declines significantly in absolute value although it still retains its statistical significance. However, in order for the coefficients of (22.1) and (22.2) to be strictly comparable, we have to adjust for steady state behavior. In particular, if we have a relationship of the form:

\[ X_t = d + B_1 Y_t + B_2 X_{t-1} \]

we can write as a condition of steady state equilibrium that \( X_t = X_{t-1} \) and consequently we have:

\[ X_t = \frac{d}{1-B_2} + \frac{B_1}{1-B_2} Y_t \]

as the steady state solution. We can apply this to the coefficients of (22.2), and we see the income coefficient in the steady state is \( \frac{.0471}{1-.929} = .663 \) while the interest coefficient is \( \frac{.0059}{1-.929} = .083 \). Having done this, we see that the steady state coefficients are actually larger than the comparable coefficients in (22.1). This in fact is relatively reassuring and is further evidence in favor a distributed lag. In view of this we shall accept (22.2) as
the best representation of the demand for money, and we shall
now turn to our income equation.


A brief word is due the lagged income variable which
appears below. Nominal this variable enters in only through
the corporate profits term, but as will be seen below, the
coefficient of lagged income is quite large. In view of this
it seems wise to attach a somewhat broader interpretation to
this variable. In particular, a distributed lag interpre-
tation which makes income respond to current and past changes
in investment and our exogenous expenditure category seems
to be called for. Following our discussion we estimated:¹

\[
(23.1) \quad Y = 1.33 + .744 E + .651 (I + AH) + .641 Y_1 + .087 S_2 Y_2 \quad \cdot \quad (1.188) \quad (1.223) \quad (1.067) \quad (1.010)
\]

\[+ .056 S_3 Y_3 + .130 S_4 Y_4; \quad R^2 = .992 \quad (1.008) \quad (1.008)\]

The income equation performs quite well, and all the coef-
ficients are several times their standard errors. The steady
state multipliers implied by (23.1) are about two for both

¹ Three differences from our earlier formulation should be
noted. First, we have omitted a net worth variable, since
a suitable measure was unavailable at the time. Secondly,
we have relaxed the a priori constraint, implied by our
derivation of the income equation above, that E and (I+AH)
have the same coefficient. As can be seen from (23.1),
however, the unrestricted estimates of the equation yielded
coefficients of a quite similar magnitude. Finally we have
omitted the stock of inventory to avoid serious problems
of multicollinearity.
the investment category and exogenous expenditure category. According to this result, about 50% of the final impact of increase in \( E \) or \((I+\Delta H)\) would be felt within six months. Since fixed investment and perhaps inventory investment depend in part on various interest rate considerations, (23.1) enables us to trace various monetary actions in terms of their eventual effects on income.

Since we have discussed all our structural equations one by one, it will be useful for purposes of discussion to have the entire estimated model consolidated. In light of our experiments we reestimated the equations selected above (most of the results above were actually from this final estimation), and we have the following:

\[
BN/DN = 28.37 - 3.416 (rd - s) - 1.751 EN/DN - 7.541 D*/DN + 4.277 (BN/DN)_{-1} + 6.131 d_5; R^2 = .726
\]

\[
(1.287) (1.446) (2.318) (.0886)
\]

\[
BN/DN = 28.37 - 3.416 (rd - s) - 1.751 EN/DN - 7.541 D*/DN + 4.277 (BN/DN)_{-1} + 6.131 d_5; R^2 = .726
\]

\[
(1.287) (1.446) (2.318) (.0886)
\]

\[
BN/DN = 28.37 - 3.416 (rd - s) - 1.751 EN/DN - 7.541 D*/DN + 4.277 (BN/DN)_{-1} + 6.131 d_5; R^2 = .726
\]

\[
(1.287) (1.446) (2.318) (.0886)
\]

\[
BN/DN = 28.37 - 3.416 (rd - s) - 1.751 EN/DN - 7.541 D*/DN + 4.277 (BN/DN)_{-1} + 6.131 d_5; R^2 = .726
\]

\[
(1.287) (1.446) (2.318) (.0886)
\]

\[
BN/DN = 28.37 - 3.416 (rd - s) - 1.751 EN/DN - 7.541 D*/DN + 4.277 (BN/DN)_{-1} + 6.131 d_5; R^2 = .726
\]

\[
(1.287) (1.446) (2.318) (.0886)
\]

\[
BN/DN = 28.37 - 3.416 (rd - s) - 1.751 EN/DN - 7.541 D*/DN + 4.277 (BN/DN)_{-1} + 6.131 d_5; R^2 = .726
\]

\[
(1.287) (1.446) (2.318) (.0886)
\]

\[
BN/DN = 28.37 - 3.416 (rd - s) - 1.751 EN/DN - 7.541 D*/DN + 4.277 (BN/DN)_{-1} + 6.131 d_5; R^2 = .726
\]

\[
(1.287) (1.446) (2.318) (.0886)
\]

\[
BN/DN = 28.37 - 3.416 (rd - s) - 1.751 EN/DN - 7.541 D*/DN + 4.277 (BN/DN)_{-1} + 6.131 d_5; R^2 = .726
\]

\[
(1.287) (1.446) (2.318) (.0886)
\]

\[
BN/DN = 28.37 - 3.416 (rd - s) - 1.751 EN/DN - 7.541 D*/DN + 4.277 (BN/DN)_{-1} + 6.131 d_5; R^2 = .726
\]

\[
(1.287) (1.446) (2.318) (.0886)
\]

\[
BN/DN = 28.37 - 3.416 (rd - s) - 1.751 EN/DN - 7.541 D*/DN + 4.277 (BN/DN)_{-1} + 6.131 d_5; R^2 = .726
\]

\[
(1.287) (1.446) (2.318) (.0886)
\]

\[
BN/DN = 28.37 - 3.416 (rd - s) - 1.751 EN/DN - 7.541 D*/DN + 4.277 (BN/DN)_{-1} + 6.131 d_5; R^2 = .726
\]

\[
(1.287) (1.446) (2.318) (.0886)
\]

\[
BN/DN = 28.37 - 3.416 (rd - s) - 1.751 EN/DN - 7.541 D*/DN + 4.277 (BN/DN)_{-1} + 6.131 d_5; R^2 = .726
\]

\[
(1.287) (1.446) (2.318) (.0886)
\]

\[
BN/DN = 28.37 - 3.416 (rd - s) - 1.751 EN/DN - 7.541 D*/DN + 4.277 (BN/DN)_{-1} + 6.131 d_5; R^2 = .726
\]

\[
(1.287) (1.446) (2.318) (.0886)
\]

\[
BN/DN = 28.37 - 3.416 (rd - s) - 1.751 EN/DN - 7.541 D*/DN + 4.277 (BN/DN)_{-1} + 6.131 d_5; R^2 = .726
\]

\[
(1.287) (1.446) (2.318) (.0886)
\]

\[
BN/DN = 28.37 - 3.416 (rd - s) - 1.751 EN/DN - 7.541 D*/DN + 4.277 (BN/DN)_{-1} + 6.131 d_5; R^2 = .726
\]

\[
(1.287) (1.446) (2.318) (.0886)
\]
SN/DN = 160.36 + 17.115 S_2 + 22.838 S_3 + 28.450 S_4 - 0.471 O^N/D^N
(6.237) (6.226) (3.669)^4 + (.098)
+ 99.764 D_5^N + 611(S^N/D^N) - 56.970 r_e; \overline{R^2} = .745
(28.342) (.090)
(13.154)

SC/D^C = 371.89 + 6.237 \overline{S_2} + 23.262 S_3 + 18.645 S_4 - .756 O^C/D^C
(5.862) (5.776) (3.603)^4 + (.100)
+ 69.062 D_5^C + 354 (S^C/D^C) - 57.833 r_e; \overline{R^2} = .838
(16.323) (.085)
(8.272)

Δ CL = .225 + .366 S_2 + .614 S_3 + .922 S_4 + .00026 AH + .052 Δ Y
(.227) (.242) (2.23) (.00010) (.015)

+.301 (r_e - r_s); \overline{R^2} = .643
(.176)

r_e - r_s = 1.558 + 9.393 A(0^N/D^N) - 0.156 B^N/D^N - 311 (Ar^s) - 1
(2.613) (.0117) (.108)
+.0573 AD^*+.0048 D^*; \overline{R^2} = .736
(.0279) (.0022)

S_t = 12.65 + 6.16 Y + .230 Δ Y - 2.097 S_2 - 3.614 S_3 - 6.378 S_4; \overline{R^2} = .969
(.016) (.112) (1.505) (1.178)^4 (.1821)^4

AH_t = 629.40 - 314.181 S_2 - 565.061 S_3 - 753.787 S_4 + 150.047 S_t
(278.150) (227.670) (390.539) (.28.237)

+.1513 Δ S_t - 197.602 H_t - 1 + 13.852 AH_t + .197 Δ H_t - 1; \overline{R^2} = .839
(.0420) (38.074) (26.839) (.083)

I/Y = .014 + .283 S_2 I/Y + .140 S_3 I/Y + .243 S_4 I/Y + .712 I/Y
(.016) (.012) (.010) (.043)

-.00142 (r_b) - 1 + .0288 Y_t - 1 / Y_t; \overline{R^2} = .942
(.00064)

M = 1.706 - .0059 (r_s Y) + .0471 Y + .588 S_2 + .427 S_3 + .569 S_4
(.0019) (.0231) (4.58) (.455) (.533)

+.929 M - 1; \overline{R^2} = .990
(.045)
F. DISCUSSION OF RESULTS.

Having concluded our structural estimation and having discussed certain specific features of the results as they were presented, we shall now turn to a somewhat more general analysis of the results. We begin our discussion with the borrowing, excess reserve, and short term security equations, paying particular attention to sectoral differences.

The first factor we note in examining these equations as a group is the differential impact that seasonal forces have on various components of country and city liquidity. City banks appear to meet all their liquidity seasonal needs by changes in their short term security holdings. This is

\[ Y = 1.33 + 0.741 \ E + 0.651 \ (I + AH) + 0.61 Y - 0.087 \ S_2 Y - 0.056 \ S_3 Y - 1 (0.188) (0.233) (0.067) - 1 (0.010) (0.008) \]

\[ + 0.130 \ S_4 Y - 1 ; \bar{R}^2 = 0.992 \]

\[ \beta - \gamma = 2.24 + 0.0735 \ \Delta D + 0.0536 \ \frac{B^N}{D^N} - 1 - 0.225 \ \Delta r - 0.119 (I + AH) (0.0265) (0.0100) - 1 (0.103) (0.028) \]

\[ + 0.204 \ S_2 - 0.148 S_3 ; \bar{R}^2 = 0.713 \]

In keeping with our original intentions we are examining the seasonal patterns of the liquidity needs measure as given by the ratio of the appropriate instrument to net demand deposits. This means, however, that the seasonal patterns presented below superimpose seasonal variations in deposits on seasonal variations in our liquidity instruments. This should be borne in mind when examining the signs and magnitudes of the seasonal coefficients above.
evidenced by the fact that city excess reserves and borrowing behavior both failed to exhibit any seasonal pattern while their short term security equation exhibited a quite pronounced seasonal pattern. Country banks on the other hand appear to avail themselves of all three liquidity instruments in order to provide for seasonal liquidity needs. In particular, borrowing increases markedly in the second quarter and declines considerably in the third, with the first and fourth quarters being roughly similar to each other and midway between the other two. Excess reserves increase steadily over the year, and short term securities do likewise although declining somewhat in the fourth quarter.

A striking feature of this overall pattern is the simultaneous marked increase in borrowings in the second quarter on the one hand, and the concommittant increase in both short term securities and excess reserves on the other. Increased liquidity demands made on country banks in the second quarter of the year are to be expected in view of the agriculture oriented nature of much of their business. The existence, however, of seasonally increased sectoral liquidity holdings, concurrent with these seasonally increased borrowings, points up the fact that our sectoral classification, while a step in the right direction, is still aggregating banks in different circumstances. The increased borrowing, however, is also partly explained by the fact that the Fed has long regarded agricultural demands as an ap-
propriate basis for member bank borrowing, and consequently many country banks who may do no borrowing for the rest of the year will feel justified in availing themselves of their discounting privilege in this circumstance.

A second factor we can note in examining this group of liquidity equations is that country bank equations uniformly achieve a higher degree of statistical explanation than their city bank counterparts. This can be seen in the table below which presents multiple correlation coefficients corrected for degrees of freedom for the three sets of equations.

<table>
<thead>
<tr>
<th></th>
<th>Country</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excess Reserves</td>
<td>.852</td>
<td>.693</td>
</tr>
<tr>
<td>Borrowing</td>
<td>.833</td>
<td>.726</td>
</tr>
<tr>
<td>Short term securities</td>
<td>.838</td>
<td>.745</td>
</tr>
</tbody>
</table>

There are several reasons which may account for this finding. First, as noted above, to the extent that city banks are following a policy of excess reserve minimization, we shall naturally experience difficulty in explaining this variable. Secondly, there is the fact that all three of the country equations yield significant seasonal patterns while only one city equation does the same. In view of this one should be somewhat cautious in comparing multiple correlation coefficients, since seasonal dummy variables tend to distort these
calculations. In fact the greatest discrepancies arise in the excess reserves and borrowings equations where seasonal factors are absent for the noncountry sector. Finally, while we have characterized the city banks as more responsive to money market conditions, we have attempted to use the same type of model to describe both country and city bank behavior, hoping that the differences in parameter estimates would reveal the differences in portfolio management philosophy. These differences are indeed revealed from parameter estimates, (see elasticities presented below), and they support the case for a more responsive city bank sector. However, it may be that the greater sophistication of city bank portfolio managers (for example, with respect to the Federal Funds market which we have blithely ignored) can not be adequately reflected in terms of the same model or function which we use to explain country bank behavior, and this may account for the statistical fits noted above. Let us now turn to some sample elasticity estimates for country and city banks.

1 Let us contrast the following two alternatives: (1) regressing a seasonally adjusted variable on a set of independent variables and (2) regressing an unadjusted variable on this same set of variables and a set of seasonal dummy variables. The coefficient of multiple correlation (uncorrected for degrees of freedom) is given by $R^2 = 1 - \frac{\Sigma e^2}{\Sigma y^2}$. Assuming in the example above that both seasonal methods account for the seasonal variation in the same way, we would have the same error sum of squares in both situations. However, $\Sigma y^2$ would be larger for the second case and would consequently produce a higher $R^2$. In practice $\Sigma e^2$ may change somewhat but generally not enough to affect this result.
Before doing so, however, it is important to reemphasize that we are presenting partial elasticities in the context of a multivariate structural model, and hence these may be of little or no use in analyzing the effects of policy actions. We have followed the convention of presenting the elasticities at the means of the variables involved. The means of the variables are listed below for reference.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>MEAN</th>
<th>VARIABLE</th>
<th>MEAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>$B^N/D^N$</td>
<td>6.010</td>
<td>$E^C/D^C$</td>
<td>3.246</td>
</tr>
<tr>
<td>$E^N/D^N$</td>
<td>2.077</td>
<td>$E^C/D^C$</td>
<td>14.865</td>
</tr>
<tr>
<td>$S^N/D^N$</td>
<td>65.88</td>
<td>$S^C/D^C$</td>
<td>101.29</td>
</tr>
<tr>
<td>$D^*/D^N$</td>
<td>2.741</td>
<td>$D^*/D^C$</td>
<td>5.085</td>
</tr>
<tr>
<td>$r_s$</td>
<td>2.203</td>
<td>$r_e$</td>
<td>4.371</td>
</tr>
<tr>
<td>$r_d$</td>
<td>2.459</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The elasticities calculated at the above means appear in the table below where N.A. stands for not available.\(^1\)

---

\(^1\) Two things should be noted. First the elasticities of the ratios with respect to the ratio terms involving $D^*$ are equivalent to the direct elasticities between $B$ (or $E$ or $S$) and $D^*$ since division by net demand deposits is merely a scale change. Secondly, $D^*$ depends on such factors as supplied reserves and reserve requirements, and hence elasticities with respect to $D^*$ are not directly convertible into those with respect to reserves. This can be seen as follows. If we write $D^*=cR$ and we assume we have estimated $S=a+bD^*=a+bcR$, then the elasticity with respect to $D^*$ is $b(D^*/S)$ where the barred quantities are the means. The elasticity with respect to $R$ (reserves) is $b(cR)/S$ which will only be equal to the above if $c$ is a constant. $c$, however, depends on reserve requirements, the distribution of deposits between time and demand, and other factors and hence cannot be assumed to remain constant.
The elasticities above with respect to the bill rate, the discount rate and the loan rate are uniformly larger for city equations than for the corresponding country bank equation. This is reassuring and supports our early contention that non-country banks are more responsive to money market conditions and come closer to being profit maximizers than their country counterparts. Having thus examined country and city bank behavior as demonstrated by the above estimates, we reaffirm our position that country and city banks have different solutions for their liquidity problems and that they resolve the tradeoff between liquidity and profits in different ways.

Despite these differences it should be noted that essentially the same variables appear to influence both sectors.

---

1 If the elasticity in the short term security equation with respect to the loan rate seems high, it should be recalled that we are working with the security-net demand deposit ratio and that an expansion of loans generally results in a decline in security holdings and a simultaneous expansion of deposits.
The only exception to this was in the case of excess reserves where the potential money supply variable, serving as our open market operations measure, failed to contribute anything to the city equation. This difference aside, the same choice of variables and functional forms appeared to work for both country and city sectors. In particular, the borrowing equations support a mixed need and profit theory. Both sectors are sensitive to the cost differential of the discount rate over the bill rate and both also took advantage of the provisions of the excess profits tax in the early part of the period under investigation. In addition, an increase in reserves supplied by the monetary authorities leads to a decline in the outstanding volume of borrowing although the elasticities differ somewhat in the two sectors. With respect to the excess reserve equation, we find that both sectors are sensitive to the cost of holding zero yield liquidity and that both sectors appear to have undergone a similar structural shift with the return of flexible monetary policy. Finally, open market operation and the yield on commercial loans both appear to be quite important in explaining the holdings of short term securities by the two sectors, as does their holdings of longer term securities.

A brief note on the policy implications of the borrowing facility is in order here. The discount window, in effect, serves as a selective monetary tool. Thus, for example, while the Fed could supply by open market operations the volume of
reserves needed to replace an unforseen loss of reserves, there is no assurance that the reserves created by open market purchases will be distributed among member banks in proportion to the reserve losses which they are intended to replace. In addition, the existence of the discount window means that borrowing can appropriately act as a way of cushioning the uneven impact of such general credit instruments as open market sales and increases in reserve requirements.

The general impression given by the Fed is that administration of the discount window is a well-integrated component of overall credit policy which acts in the same direction as open market operations. Thus, there is a tendency on the part of some Federal Reserve officials to view increased member bank borrowing as a force intensifying credit restraint. One argument behind this attitude is that member banks in keeping with their tradition against borrowing will turn away private borrowers when they themselves are forced to borrow from the Fed. In addition, however, it is asserted that to the extent that member banks actually borrow this will further aid monetary policy. This is claimed to be the case because bankers are known to be adverse to remaining in debt over any period of time.

"Consequently, the reserves created to meet the seasonal or other temporary need are likely to be extinguished automatically when the need has passed rather than be absorbed in the credit ex-
What is likely to be true is that for a given total volume of member bank reserves, the larger the share generated by borrowings, the more restrictive is the lending policy of member banks. However, the view cited above ignores the important fact before demonstrated that member bank borrowing actually increases the volume of member bank reserves and in fact offsets some of the stringency created by open market operations. This does not mean that monetary policy cannot accomplish its objectives although it may be less effective in the sense of requiring a larger volume of open market operations to achieve a given effect. It does means, however, that Federal Reserve strategy should be guided by the predictable portfolio readjustments on the part of its member banks. Hence, if the Fed desires to control the supply of money, it should incorporate into its decision process schedules similar to the borrowing and excess reserve functions calculated above. The virtue of explicitly deriving structural estimates is that we can shed some light on the quantitative effects of various monetary policies.

There is a final policy point with respect to using the discount rate as an indication of the intentions of the monetary authorities. In the minority is the opinion voiced by 1 [59,p.226] This attitude toward the role of the discount mechanism during a period of credit restraint is reflected in the practice of using the level of free reserves as an indication of the tightness in the money market.

2 Our borrowing equations clearly make room for changes in the discount rate as a potential monetary tool and in fact can explicitly yield estimates of the quantitative impact of changing $r_d$. Before using this tool, however, one must investigate more carefully the possible effects on expectations which we have heretofore ignored.
the Federal Reserve official who states:

"The time-honored device of raising or lowering dis-
count rates, however, can hardly be susceptible
to misinterpretation by even the most uninformed
observers." ¹

Many writers have indicated an uneasiness connected with
the stability of the psychological reaction generated by a
change in the discount rate.² For example, raising the rate
in the early stages of an upswing may "announce" that the
Fed thinks there is going to be a boom and further encourage
expansionary activity. On the other hand if boom expectations
are already formed, and businessmen think the announcement
means the Fed intends (and is able!) to create credit dif-
ficulties for them at a later stage, then there might be
some curtailment of production and capital expansion plans.
To avoid this unstable expectational effect, it has been sug-
gested that we follow the Canadian experience and tie the
discount rate to a short term money market rate (e.g., the
rate on 90 day Treasury bills). While this may not be neces-
sary, some discount rate policy reform does seem in order.
In particular, "The banks vacillation between active and
passive rate policies during recent years has badly confused
both amateur and expert observers." ³

¹ [59, p. 230]
² See for example [25, p. 449] and [52]
³ See [25, p. 450]. Milton Friedman has in fact suggested
that the solution is the abolition of the discount win-
down entirely. See his testimony in [23, part 4, p. 636].
The discussion of the excess reserves and borrowing equations in effect (via (15.3)) provide a link between the supply of money and the several interest rates in the model as well with various instruments under the control of the Federal Reserve authorities. In particular, we have related the supply of money to the discount rate and to open market operation and reserve requirement changes (via D*). To complete our discussion, let us now turn to the demand for money equation.

Teigen, as noted above, has estimated the same functional form for a slightly different time period. Unfortunately for comparative purposes, the money stock series has been revised since his estimation, and hence the two sets of results can not be seriously compared. However, it will be helpful to indicate briefly his findings. His equivalent of (22.1) was:

\[ M = 69.5 - 0.0041 rY + 0.1603 Y + \text{Seasonals}; \bar{R}^2 = 0.976 \]

\[ (0.0015) (0.0136) \]

while the equivalent of (22.2) was:

\[ M = 23.1 - 0.0025 rY + 0.0618 Y + 0.686 M_{-1} + \text{Seasonals}; \bar{R}^2 = 0.992 \]

\[ (0.0007) (0.0026) (0.0728) \]

Several differences can be noted. Teigen's unlagged version produces a much better fit than ours and has a cor-

---

1 In addition to this change in the basic money supply series, there are two other differences which should be noted. First, Teigen's postwar equation runs from the fourth quarter of 1946 to the fourth quarter of 1959, while ours runs from the third quarter of 1950 to the second quarter of 1962. Secondly, Teigen uses quarterly call dates for measuring his data, while we use observations for the last month of the quarter.
rectly signed interest coefficient which is significant. The fit of our two lagged equations are quite similar although his interest coefficient declines in value while ours increases when we add a lagged money stock variable. The income variables move in the same direction. The steady state elasticities calculated at the mean are compared below.

<table>
<thead>
<tr>
<th></th>
<th>Teigen</th>
<th>From (22.2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>r</td>
<td>-0.054</td>
<td>-0.144</td>
</tr>
<tr>
<td>Y</td>
<td>0.513</td>
<td>0.356</td>
</tr>
</tbody>
</table>

These estimates, while somewhat different, are certainly in the same ball park, which is reassuring.\(^1\)

We have thus far discussed the demand and supply of money and have in passing made several oblique references to the possible quantitative policy implications which could be derived from our structural estimates, but we have only presented some partial elasticity estimates. Thus, for example, in discussing borrowing, we examined the direct effects of changes in the discount rate or in the potential money supply. These direct effects will be compounded, however, when the

---

\(^1\) The income elasticities presented in the above table seem somewhat small for steady state elasticities. There are several possible sources of misspecification of our demand for money equation which may contribute to these small elasticities. For example, we have ignored time and savings deposits and have made no explicit allowance for substitution between money and these assets. In recent years the increase in yield obtainable on time deposits has caused shifts out of demand deposits into time deposits, and this would show up as a decreased elasticity. Similarly, secular changes in velocity might also have this effect.
changed policy variables interact with other variables affecting borrowing. What is clearly needed for policy purposes is a method which takes account of the interactions of the entire system. The standard approach to this leads to the problem of solving a set of simultaneous linear equations whose unknowns are the total derivatives of each of the structural equations. This is implemented by substituting into the general model values of the coefficients as estimated above and appropriate values of the exogenous variables.¹ The analytic solution of a fifteen equation system, which is what the problem reduces to in this instance, would be extremely laborious, and hence a numerical solution by computer seems to be the most feasible alternative. This endeavor, however, would require more time to accomplish than was presently available, and, somewhat unfortunately, this phase of our investigation was relegated to a future date.

Several other particular features of our results could be mentioned at this juncture, but they more appropriately belong to a summary of findings, and hence we now turn to our concluding chapter.

---

¹ For an illustration of this technique in the context of a three equation model, see the contribution by Teigen, [54, Chap. VI]
CHAPTER V

CONCLUDING REMARKS

The first section of this chapter will be devoted to some comments on the results of general interest, while the second shall briefly indicate some of the problems we have assumed for purposes of this study.

A. SUMMARY

We have presented above a macroeconomic model of the U.S. economy, which has paid special attention to the role of the monetary sector, both as an economic decision making unit and as it interacts with the remaining sectors of the economy. We shall discuss each of these roles in turn.

With respect to the banking system per se, we have replaced the traditional reserve-multiplier approach to the determination of the money supply with an approach emphasizing bank asset decisions. In particular, we have examined holdings of excess reserves, borrowings, and short term securities and demonstrated how the determination by the banks of the equilibrium level of these assets contributes to the determination of the supply of money. Furthermore, in the econometric implementation of our model for the post-war period, we have found it necessary to disaggregate the banking sector into country and city banks. These two types of banks appear to be operating under different management philosophies, and this manifests itself, in part, in the di-
vergent ways in which they provide for their liquidity needs. In particular, the city banks, somewhat reassuringly, are relatively more responsive to cost considerations and behave in a manner more consonant with a profit maximization model. Finally, we examined the banks' allocation of funds to the category of commercial and industrial loans, and we presented an explanation for the determination of the rate on these loans.

One theme which ran through all of these investigations was the broad role available to open market operations in influencing bank asset choices and various interest rates. More specifically, our open market variable was found to contribute significantly to the explanation of the holdings of the various liquid assets and to the differentials of the loan rate over the bill rate and of the bond rate over the bill rate. The usefulness of this finding for monetary policy, however, depends on the linkages of the monetary and real sectors, and we now turn briefly to this aspect of our study.

In this regard our findings furnish evidence on the nature of the demand for money, the demand for commercial loans, and the interest sensitivity of fixed investments. Under our assumptions, transactions balances form the only basis for a demand for money. However, the transaction demand is posited as being sensitive to variations in short term interest rates, and this hypothesis is supported by the statistical
evidence presented above. The demand for commercial loans is also found to be sensitive to the rate on these loans as well as to the volume of inventory investment. Fixed investment is similarly found to be responsive to a long term interest rate as well as to an accelerator type of output variable. Our income equation depends in turn on our investment variables (yielding, it should be noted, an appropriately sized multiplier) and hence indirectly on various monetary variables. We thus have a nominally closed model which allows for the interaction of the monetary and real sectors and permits via various interest linkages the impacts of monetary policy to be felt in both the banking and nonbanking sectors.

It should be noted that the only negative finding with respect to the linkages of the monetary and real sectors concerned the determinants of inventory investment where we had little success in finding a significant role for a monetary variable. However, the important role inventory demand plays in explaining the demand for commercial loans and other a priori reasons cited above leads us to suspect that we have not formulated this equation in the most satisfactory way. This is further supported by the clear presence of multicollinearity in the inventory equation estimates presented above and indicates that these results warrant further investigation.
B. SUGGESTIONS FOR FUTURE RESEARCH.

Following the broad lines set forth in the above study there are two different types of investigation which can be suggested for further research. We have already mentioned the first one, namely, an analysis of the policy implications of the present system. This would not require the resolution of any economic issues but rather would entail a somewhat time consuming analysis to satisfactorily treat the various technical problems. Upon completing this task, however, we would then be in a position to present some estimates of the quantitative impact of various monetary policy actions.

The second type of investigation would involve refining the model set forth above. There are, of course, numerous respects in which this might be done, and we shall naturally only suggest a few. First, as already noted, one might transform the inventory equation into a form similar to that used in the fixed investment equation. This would remove the multicollinearity problem and perhaps permit a more satisfactory identification of economic forces. Perhaps disaggregation of this result would also be desirable.

Secondly, we have restricted our attention only to certain short term assets of the commercial banks. A more complete examination would involve investigating bank demand for long term securities and other categories of loans such as mortgage and consumer loans. This would involve elucidation of optimal bank portfolio behavior under uncertainty, a sub-
ject which only recently has been getting its share of attention in the economic literature. Thirdly, we have excluded time and saving deposits from our scope and this has probably introduced specification errors into our system. In particular, the growing importance of time and savings deposits in the public's portfolio means that the demand for "money" equation should take account of the substitution between various types of deposits.

These are only a sample of the possible refinements to our investigation, and they appropriately indicate the preliminary nature of our study.
<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
</tr>
<tr>
<td>503</td>
<td>2.95</td>
<td>1.30</td>
<td>1.75</td>
<td>2.36</td>
<td>71.6</td>
</tr>
<tr>
<td>504</td>
<td>3.10</td>
<td>1.34</td>
<td>1.75</td>
<td>2.39</td>
<td>70.8</td>
</tr>
<tr>
<td>511</td>
<td>3.27</td>
<td>1.40</td>
<td>1.75</td>
<td>2.47</td>
<td>68.7</td>
</tr>
<tr>
<td>512</td>
<td>3.32</td>
<td>1.45</td>
<td>1.75</td>
<td>2.65</td>
<td>69.8</td>
</tr>
<tr>
<td>513</td>
<td>3.36</td>
<td>1.63</td>
<td>1.75</td>
<td>2.56</td>
<td>70.3</td>
</tr>
<tr>
<td>514</td>
<td>3.49</td>
<td>1.73</td>
<td>1.75</td>
<td>2.70</td>
<td>72.3</td>
</tr>
<tr>
<td>521</td>
<td>3.66</td>
<td>1.59</td>
<td>1.75</td>
<td>2.70</td>
<td>71.6</td>
</tr>
<tr>
<td>522</td>
<td>3.72</td>
<td>1.70</td>
<td>1.75</td>
<td>2.61</td>
<td>71.0</td>
</tr>
<tr>
<td>523</td>
<td>3.74</td>
<td>1.71</td>
<td>1.75</td>
<td>2.71</td>
<td>69.6</td>
</tr>
<tr>
<td>524</td>
<td>3.77</td>
<td>2.09</td>
<td>1.75</td>
<td>2.75</td>
<td>72.6</td>
</tr>
<tr>
<td>531</td>
<td>3.75</td>
<td>2.01</td>
<td>2.00</td>
<td>2.89</td>
<td>71.6</td>
</tr>
<tr>
<td>532</td>
<td>3.91</td>
<td>2.11</td>
<td>2.00</td>
<td>3.13</td>
<td>74.6</td>
</tr>
<tr>
<td>533</td>
<td>3.93</td>
<td>1.79</td>
<td>2.00</td>
<td>3.01</td>
<td>79.6</td>
</tr>
<tr>
<td>534</td>
<td>3.96</td>
<td>1.60</td>
<td>2.00</td>
<td>2.79</td>
<td>79.1</td>
</tr>
<tr>
<td>541</td>
<td>3.94</td>
<td>1.03</td>
<td>1.75</td>
<td>2.53</td>
<td>65.3</td>
</tr>
<tr>
<td>542</td>
<td>3.89</td>
<td>0.64</td>
<td>1.50</td>
<td>2.55</td>
<td>65.2</td>
</tr>
<tr>
<td>543</td>
<td>3.82</td>
<td>1.01</td>
<td>1.50</td>
<td>2.52</td>
<td>70.6</td>
</tr>
<tr>
<td>544</td>
<td>3.84</td>
<td>1.14</td>
<td>1.50</td>
<td>2.59</td>
<td>69.7</td>
</tr>
<tr>
<td>551</td>
<td>3.83</td>
<td>1.28</td>
<td>1.50</td>
<td>2.78</td>
<td>64.6</td>
</tr>
<tr>
<td>552</td>
<td>3.83</td>
<td>1.41</td>
<td>1.75</td>
<td>2.82</td>
<td>66.4</td>
</tr>
<tr>
<td>553</td>
<td>3.99</td>
<td>2.07</td>
<td>2.25</td>
<td>2.92</td>
<td>69.7</td>
</tr>
<tr>
<td>554</td>
<td>4.14</td>
<td>2.54</td>
<td>2.50</td>
<td>2.91</td>
<td>75.8</td>
</tr>
<tr>
<td>561</td>
<td>4.13</td>
<td>2.25</td>
<td>2.50</td>
<td>2.93</td>
<td>72.8</td>
</tr>
<tr>
<td>562</td>
<td>4.34</td>
<td>2.49</td>
<td>2.75</td>
<td>2.93</td>
<td>68.0</td>
</tr>
<tr>
<td>563</td>
<td>4.52</td>
<td>2.84</td>
<td>3.00</td>
<td>3.21</td>
<td>71.7</td>
</tr>
<tr>
<td>564</td>
<td>4.63</td>
<td>3.21</td>
<td>3.00</td>
<td>3.40</td>
<td>85.5</td>
</tr>
<tr>
<td>571</td>
<td>4.59</td>
<td>3.08</td>
<td>3.00</td>
<td>3.26</td>
<td>86.6</td>
</tr>
<tr>
<td>572</td>
<td>4.61</td>
<td>3.29</td>
<td>3.00</td>
<td>3.58</td>
<td>87.9</td>
</tr>
<tr>
<td>573</td>
<td>5.01</td>
<td>3.53</td>
<td>3.50</td>
<td>3.66</td>
<td>92.2</td>
</tr>
<tr>
<td>574</td>
<td>5.01</td>
<td>3.04</td>
<td>3.00</td>
<td>3.30</td>
<td>95.0</td>
</tr>
<tr>
<td>581</td>
<td>4.75</td>
<td>1.30</td>
<td>2.25</td>
<td>3.25</td>
<td>88.3</td>
</tr>
<tr>
<td>582</td>
<td>4.40</td>
<td>0.83</td>
<td>1.75</td>
<td>3.19</td>
<td>82.4</td>
</tr>
<tr>
<td>583</td>
<td>4.47</td>
<td>2.44</td>
<td>2.00</td>
<td>3.75</td>
<td>91.1</td>
</tr>
<tr>
<td>584</td>
<td>4.68</td>
<td>2.77</td>
<td>2.50</td>
<td>3.80</td>
<td>97.6</td>
</tr>
<tr>
<td>591</td>
<td>4.74</td>
<td>2.80</td>
<td>3.00</td>
<td>3.92</td>
<td>102.1</td>
</tr>
<tr>
<td>592</td>
<td>5.06</td>
<td>3.21</td>
<td>3.50</td>
<td>4.09</td>
<td>102.6</td>
</tr>
<tr>
<td>593</td>
<td>5.43</td>
<td>4.04</td>
<td>4.00</td>
<td>4.26</td>
<td>107.1</td>
</tr>
<tr>
<td>594</td>
<td>5.54</td>
<td>4.49</td>
<td>4.00</td>
<td>4.27</td>
<td>111.9</td>
</tr>
<tr>
<td>601</td>
<td>5.50</td>
<td>3.31</td>
<td>4.00</td>
<td>4.08</td>
<td>116.1</td>
</tr>
<tr>
<td>602</td>
<td>5.53</td>
<td>2.46</td>
<td>3.50</td>
<td>3.99</td>
<td>113.0</td>
</tr>
<tr>
<td>603</td>
<td>5.21</td>
<td>2.48</td>
<td>3.00</td>
<td>3.82</td>
<td>113.9</td>
</tr>
<tr>
<td>604</td>
<td>5.21</td>
<td>2.25</td>
<td>3.00</td>
<td>3.88</td>
<td>116.3</td>
</tr>
<tr>
<td>611</td>
<td>5.20</td>
<td>2.39</td>
<td>3.00</td>
<td>3.78</td>
<td>109.1</td>
</tr>
<tr>
<td>612</td>
<td>5.18</td>
<td>2.33</td>
<td>3.00</td>
<td>3.88</td>
<td>111.2</td>
</tr>
<tr>
<td>613</td>
<td>5.19</td>
<td>2.28</td>
<td>3.00</td>
<td>4.02</td>
<td>116.6</td>
</tr>
<tr>
<td>614</td>
<td>5.21</td>
<td>2.60</td>
<td>3.00</td>
<td>4.06</td>
<td>121.2</td>
</tr>
<tr>
<td>621</td>
<td>5.21</td>
<td>2.72</td>
<td>3.00</td>
<td>4.01</td>
<td>117.3</td>
</tr>
<tr>
<td>622</td>
<td>5.25</td>
<td>2.73</td>
<td>3.00</td>
<td>3.90</td>
<td>116.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>503</td>
<td>3.30</td>
<td>21.38</td>
<td>1.31</td>
<td>.812</td>
<td>57.5</td>
</tr>
<tr>
<td>504</td>
<td>6.18</td>
<td>23.59</td>
<td>1.92</td>
<td>1.032</td>
<td>53.6</td>
</tr>
<tr>
<td>511</td>
<td>3.73</td>
<td>17.30</td>
<td>3.10</td>
<td>2.070</td>
<td>29.0</td>
</tr>
<tr>
<td>512</td>
<td>5.65</td>
<td>17.69</td>
<td>1.71</td>
<td>2.436</td>
<td>67.8</td>
</tr>
<tr>
<td>513</td>
<td>2.59</td>
<td>19.50</td>
<td>4.82</td>
<td>1.754</td>
<td>87.3</td>
</tr>
<tr>
<td>514</td>
<td>3.73</td>
<td>19.65</td>
<td>9.22</td>
<td>2.934</td>
<td>119.5</td>
</tr>
<tr>
<td>521</td>
<td>5.11</td>
<td>19.16</td>
<td>4.11</td>
<td>1.903</td>
<td>106.2</td>
</tr>
<tr>
<td>522</td>
<td>2.70</td>
<td>18.07</td>
<td>7.69</td>
<td>3.621</td>
<td>116.0</td>
</tr>
<tr>
<td>523</td>
<td>3.63</td>
<td>17.76</td>
<td>8.62</td>
<td>4.840</td>
<td>86.9</td>
</tr>
<tr>
<td>524</td>
<td>2.29</td>
<td>17.79</td>
<td>21.12</td>
<td>7.291</td>
<td>95.0</td>
</tr>
<tr>
<td>531</td>
<td>1.72</td>
<td>15.15</td>
<td>17.04</td>
<td>4.840</td>
<td>55.4</td>
</tr>
<tr>
<td>532</td>
<td>4.91</td>
<td>15.77</td>
<td>3.78</td>
<td>6.264</td>
<td>69.2</td>
</tr>
<tr>
<td>533</td>
<td>2.34</td>
<td>17.95</td>
<td>5.77</td>
<td>3.445</td>
<td>116.5</td>
</tr>
<tr>
<td>534</td>
<td>1.56</td>
<td>18.15</td>
<td>5.31</td>
<td>3.208</td>
<td>113.5</td>
</tr>
<tr>
<td>541</td>
<td>2.09'</td>
<td>17.54</td>
<td>2.01</td>
<td>2.025</td>
<td>79.3</td>
</tr>
<tr>
<td>542</td>
<td>3.67</td>
<td>19.84</td>
<td>1.27</td>
<td>2.110</td>
<td>79.3</td>
</tr>
<tr>
<td>543</td>
<td>2.07</td>
<td>19.98</td>
<td>.62</td>
<td>.867</td>
<td>95.6</td>
</tr>
<tr>
<td>544</td>
<td>1.53</td>
<td>17.62</td>
<td>2.92</td>
<td>1.522</td>
<td>70.1</td>
</tr>
<tr>
<td>551</td>
<td>1.25</td>
<td>15.05</td>
<td>5.68</td>
<td>3.010</td>
<td>54.5</td>
</tr>
<tr>
<td>552</td>
<td>1.14</td>
<td>14.66</td>
<td>4.39</td>
<td>3.518</td>
<td>28.2</td>
</tr>
<tr>
<td>553</td>
<td>1.21</td>
<td>14.17</td>
<td>11.39</td>
<td>3.549</td>
<td>21.5</td>
</tr>
<tr>
<td>554</td>
<td>1.47</td>
<td>14.01</td>
<td>10.34</td>
<td>4.481</td>
<td>35.0</td>
</tr>
<tr>
<td>561</td>
<td>1.78</td>
<td>13.53</td>
<td>13.05</td>
<td>4.348</td>
<td>20.2</td>
</tr>
<tr>
<td>562</td>
<td>1.49</td>
<td>13.72</td>
<td>9.24</td>
<td>4.983</td>
<td>17.0</td>
</tr>
<tr>
<td>563</td>
<td>1.26</td>
<td>14.15</td>
<td>10.45</td>
<td>3.352</td>
<td>23.1</td>
</tr>
<tr>
<td>564</td>
<td>2.47</td>
<td>13.41</td>
<td>8.23</td>
<td>3.958</td>
<td>40.8</td>
</tr>
<tr>
<td>571</td>
<td>1.22</td>
<td>12.56</td>
<td>10.60</td>
<td>4.539</td>
<td>37.3</td>
</tr>
<tr>
<td>572</td>
<td>.91</td>
<td>12.42</td>
<td>12.17</td>
<td>6.464</td>
<td>46.8</td>
</tr>
<tr>
<td>573</td>
<td>1.07</td>
<td>12.11</td>
<td>13.70</td>
<td>3.413</td>
<td>41.5</td>
</tr>
<tr>
<td>574</td>
<td>1.97</td>
<td>12.40</td>
<td>8.29</td>
<td>4.749</td>
<td>51.6</td>
</tr>
<tr>
<td>581</td>
<td>2.40</td>
<td>13.72</td>
<td>1.04</td>
<td>2.033</td>
<td>46.1</td>
</tr>
<tr>
<td>582</td>
<td>2.15</td>
<td>13.70</td>
<td>1.01</td>
<td>2.108</td>
<td>53.6</td>
</tr>
<tr>
<td>583</td>
<td>1.47</td>
<td>13.18</td>
<td>5.78</td>
<td>2.669</td>
<td>79.1</td>
</tr>
<tr>
<td>584</td>
<td>1.27</td>
<td>11.34</td>
<td>5.83</td>
<td>4.271</td>
<td>88.7</td>
</tr>
<tr>
<td>591</td>
<td>1.22</td>
<td>10.35</td>
<td>6.31</td>
<td>5.080</td>
<td>88.2</td>
</tr>
<tr>
<td>592</td>
<td>.75</td>
<td>9.63</td>
<td>10.09</td>
<td>6.949</td>
<td>65.2</td>
</tr>
<tr>
<td>593</td>
<td>.39</td>
<td>10.07</td>
<td>10.43</td>
<td>5.639</td>
<td>37.5</td>
</tr>
<tr>
<td>594</td>
<td>.47</td>
<td>11.86</td>
<td>10.17</td>
<td>5.616</td>
<td>46.7</td>
</tr>
<tr>
<td>601</td>
<td>.84</td>
<td>9.62</td>
<td>7.19</td>
<td>4.771</td>
<td>29.3</td>
</tr>
<tr>
<td>602</td>
<td>1.20</td>
<td>10.38</td>
<td>3.77</td>
<td>4.923</td>
<td>31.0</td>
</tr>
<tr>
<td>603</td>
<td>1.35</td>
<td>14.60</td>
<td>2.14</td>
<td>2.252</td>
<td>60.4</td>
</tr>
<tr>
<td>604</td>
<td>2.00</td>
<td>16.55</td>
<td>.71</td>
<td>1.041</td>
<td>75.2</td>
</tr>
<tr>
<td>611</td>
<td>1.15</td>
<td>12.41</td>
<td>.48</td>
<td>1.006</td>
<td>56.9</td>
</tr>
<tr>
<td>612</td>
<td>1.97</td>
<td>12.75</td>
<td>.28</td>
<td>1.188</td>
<td>91.0</td>
</tr>
<tr>
<td>613</td>
<td>1.08</td>
<td>13.31</td>
<td>.27</td>
<td>4.888</td>
<td>115.6</td>
</tr>
<tr>
<td>614</td>
<td>1.04</td>
<td>12.45</td>
<td>1.73</td>
<td>.769</td>
<td>100.4</td>
</tr>
<tr>
<td>621</td>
<td>1.29</td>
<td>10.87</td>
<td>.57</td>
<td>.816</td>
<td>97.1</td>
</tr>
<tr>
<td>622</td>
<td>1.62</td>
<td>10.64</td>
<td>.80</td>
<td>.856</td>
<td>85.0</td>
</tr>
<tr>
<td>(15)</td>
<td>(16)</td>
<td>(17)</td>
<td>(18)</td>
<td>(19)</td>
<td>(20)</td>
</tr>
<tr>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>503</td>
<td>73.1</td>
<td>115.0</td>
<td>20.3</td>
<td>139.4</td>
<td>2.47</td>
</tr>
<tr>
<td>504</td>
<td>80.1</td>
<td>119.5</td>
<td>19.1</td>
<td>139.9</td>
<td>2.38</td>
</tr>
<tr>
<td>511</td>
<td>77.0</td>
<td>116.8</td>
<td>23.2</td>
<td>142.7</td>
<td>2.42</td>
</tr>
<tr>
<td>512</td>
<td>80.6</td>
<td>117.5</td>
<td>23.7</td>
<td>144.6</td>
<td>2.65</td>
</tr>
<tr>
<td>513</td>
<td>82.7</td>
<td>119.9</td>
<td>27.2</td>
<td>144.4</td>
<td>2.63</td>
</tr>
<tr>
<td>514</td>
<td>88.7</td>
<td>126.3</td>
<td>25.7</td>
<td>147.2</td>
<td>2.39</td>
</tr>
<tr>
<td>521</td>
<td>82.9</td>
<td>123.2</td>
<td>29.3</td>
<td>150.6</td>
<td>2.47</td>
</tr>
<tr>
<td>522</td>
<td>84.5</td>
<td>124.2</td>
<td>28.3</td>
<td>151.5</td>
<td>2.48</td>
</tr>
<tr>
<td>523</td>
<td>85.6</td>
<td>125.6</td>
<td>30.1</td>
<td>153.7</td>
<td>2.49</td>
</tr>
<tr>
<td>524</td>
<td>94.1</td>
<td>131.1</td>
<td>28.0</td>
<td>155.4</td>
<td>2.42</td>
</tr>
<tr>
<td>531</td>
<td>91.9</td>
<td>127.3</td>
<td>30.4</td>
<td>155.3</td>
<td>2.58</td>
</tr>
<tr>
<td>533</td>
<td>91.0</td>
<td>127.7</td>
<td>30.7</td>
<td>159.7</td>
<td>2.57</td>
</tr>
<tr>
<td>534</td>
<td>94.4</td>
<td>132.5</td>
<td>28.3</td>
<td>158.7</td>
<td>2.51</td>
</tr>
<tr>
<td>541</td>
<td>87.1</td>
<td>128.2</td>
<td>29.4</td>
<td>161.7</td>
<td>2.62</td>
</tr>
<tr>
<td>542</td>
<td>89.5</td>
<td>128.9</td>
<td>28.9</td>
<td>164.8</td>
<td>2.65</td>
</tr>
<tr>
<td>543</td>
<td>89.6</td>
<td>130.2</td>
<td>29.8</td>
<td>167.5</td>
<td>2.67</td>
</tr>
<tr>
<td>544</td>
<td>97.0</td>
<td>136.4</td>
<td>27.9</td>
<td>170.3</td>
<td>2.96</td>
</tr>
<tr>
<td>551</td>
<td>92.7</td>
<td>132.6</td>
<td>31.8</td>
<td>169.7</td>
<td>2.65</td>
</tr>
<tr>
<td>552</td>
<td>97.7</td>
<td>133.7</td>
<td>31.7</td>
<td>170.5</td>
<td>2.65</td>
</tr>
<tr>
<td>553</td>
<td>100.0</td>
<td>134.4</td>
<td>32.9</td>
<td>170.6</td>
<td>2.67</td>
</tr>
<tr>
<td>554</td>
<td>107.1</td>
<td>139.2</td>
<td>29.6</td>
<td>169.3</td>
<td>2.57</td>
</tr>
<tr>
<td>561</td>
<td>98.9</td>
<td>134.9</td>
<td>31.3</td>
<td>171.8</td>
<td>2.66</td>
</tr>
<tr>
<td>562</td>
<td>102.5</td>
<td>135.4</td>
<td>31.1</td>
<td>170.9</td>
<td>2.65</td>
</tr>
<tr>
<td>563</td>
<td>104.4</td>
<td>135.4</td>
<td>34.0</td>
<td>172.0</td>
<td>2.67</td>
</tr>
<tr>
<td>564</td>
<td>113.4</td>
<td>141.0</td>
<td>29.9</td>
<td>174.4</td>
<td>2.64</td>
</tr>
<tr>
<td>571</td>
<td>105.2</td>
<td>135.8</td>
<td>33.9</td>
<td>175.8</td>
<td>2.76</td>
</tr>
<tr>
<td>572</td>
<td>110.0</td>
<td>135.8</td>
<td>34.9</td>
<td>176.2</td>
<td>2.76</td>
</tr>
<tr>
<td>573</td>
<td>110.9</td>
<td>135.8</td>
<td>36.2</td>
<td>175.9</td>
<td>2.78</td>
</tr>
<tr>
<td>574</td>
<td>116.7</td>
<td>139.9</td>
<td>33.5</td>
<td>177.2</td>
<td>2.73</td>
</tr>
<tr>
<td>581</td>
<td>104.2</td>
<td>134.8</td>
<td>34.3</td>
<td>183.4</td>
<td>2.86</td>
</tr>
<tr>
<td>582</td>
<td>108.4</td>
<td>136.9</td>
<td>36.1</td>
<td>188.3</td>
<td>2.80</td>
</tr>
<tr>
<td>583</td>
<td>110.8</td>
<td>138.7</td>
<td>37.9</td>
<td>190.7</td>
<td>2.90</td>
</tr>
<tr>
<td>584</td>
<td>121.2</td>
<td>145.3</td>
<td>37.0</td>
<td>192.3</td>
<td>2.84</td>
</tr>
<tr>
<td>591</td>
<td>113.4</td>
<td>141.0</td>
<td>37.3</td>
<td>194.5</td>
<td>2.96</td>
</tr>
<tr>
<td>592</td>
<td>121.1</td>
<td>141.8</td>
<td>41.5</td>
<td>194.7</td>
<td>2.97</td>
</tr>
<tr>
<td>593</td>
<td>119.1</td>
<td>142.4</td>
<td>39.7</td>
<td>194.6</td>
<td>2.95</td>
</tr>
<tr>
<td>594</td>
<td>129.0</td>
<td>145.9</td>
<td>37.9</td>
<td>194.5</td>
<td>2.85</td>
</tr>
<tr>
<td>601</td>
<td>120.8</td>
<td>139.0</td>
<td>39.5</td>
<td>193.5</td>
<td>3.06</td>
</tr>
<tr>
<td>602</td>
<td>125.9</td>
<td>138.5</td>
<td>40.5</td>
<td>194.0</td>
<td>3.06</td>
</tr>
<tr>
<td>603</td>
<td>124.2</td>
<td>140.3</td>
<td>40.8</td>
<td>196.1</td>
<td>3.00</td>
</tr>
<tr>
<td>604</td>
<td>132.6</td>
<td>145.3</td>
<td>39.5</td>
<td>201.2</td>
<td>3.03</td>
</tr>
<tr>
<td>611</td>
<td>120.6</td>
<td>140.7</td>
<td>38.8</td>
<td>204.0</td>
<td>3.05</td>
</tr>
<tr>
<td>612</td>
<td>128.1</td>
<td>140.8</td>
<td>42.6</td>
<td>204.1</td>
<td>3.12</td>
</tr>
<tr>
<td>613</td>
<td>128.9</td>
<td>143.0</td>
<td>43.1</td>
<td>209.9</td>
<td>3.18</td>
</tr>
<tr>
<td>614</td>
<td>141.2</td>
<td>150.2</td>
<td>42.8</td>
<td>214.9</td>
<td>3.14</td>
</tr>
<tr>
<td>621</td>
<td>130.8</td>
<td>143.7</td>
<td>43.9</td>
<td>215.5</td>
<td>3.31</td>
</tr>
<tr>
<td>622</td>
<td>138.1</td>
<td>143.6</td>
<td>46.2</td>
<td>216.3</td>
<td>3.22</td>
</tr>
<tr>
<td></td>
<td>(22)</td>
<td>(23)</td>
<td>(24)</td>
<td>(25)</td>
<td>(26)</td>
</tr>
<tr>
<td>----</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>503</td>
<td>21.51</td>
<td>29.96</td>
<td>54.83</td>
<td>5.251</td>
<td>0.129</td>
</tr>
<tr>
<td>504</td>
<td>31.85</td>
<td>34.27</td>
<td>58.13</td>
<td>6.322</td>
<td>0.282</td>
</tr>
<tr>
<td>511</td>
<td>36.17</td>
<td>36.53</td>
<td>60.82</td>
<td>5.465</td>
<td>0.164</td>
</tr>
<tr>
<td>512</td>
<td>50.23</td>
<td>39.92</td>
<td>61.95</td>
<td>6.502</td>
<td>0.194</td>
</tr>
<tr>
<td>513</td>
<td>57.35</td>
<td>41.63</td>
<td>58.92</td>
<td>6.505</td>
<td>0.119</td>
</tr>
<tr>
<td>514</td>
<td>61.88</td>
<td>43.40</td>
<td>62.80</td>
<td>7.173</td>
<td>0.100</td>
</tr>
<tr>
<td>521</td>
<td>64.14</td>
<td>43.85</td>
<td>60.58</td>
<td>6.229</td>
<td>0.056</td>
</tr>
<tr>
<td>522</td>
<td>67.81</td>
<td>42.96</td>
<td>61.55</td>
<td>6.816</td>
<td>0.037</td>
</tr>
<tr>
<td>523</td>
<td>71.37</td>
<td>42.87</td>
<td>60.98</td>
<td>6.242</td>
<td>0.004</td>
</tr>
<tr>
<td>524</td>
<td>75.11</td>
<td>44.32</td>
<td>67.92</td>
<td>7.206</td>
<td>0.069</td>
</tr>
<tr>
<td>531</td>
<td>73.18</td>
<td>44.40</td>
<td>66.58</td>
<td>6.339</td>
<td>0.137</td>
</tr>
<tr>
<td>532</td>
<td>73.31</td>
<td>44.94</td>
<td>69.50</td>
<td>7.274</td>
<td>0.069</td>
</tr>
<tr>
<td>533</td>
<td>71.05</td>
<td>45.32</td>
<td>67.34</td>
<td>7.084</td>
<td>0.049</td>
</tr>
<tr>
<td>534</td>
<td>64.81</td>
<td>45.43</td>
<td>65.67</td>
<td>7.625</td>
<td>0.019</td>
</tr>
<tr>
<td>541</td>
<td>56.67</td>
<td>45.37</td>
<td>61.93</td>
<td>6.266</td>
<td>0.088</td>
</tr>
<tr>
<td>542</td>
<td>51.71</td>
<td>44.19</td>
<td>63.85</td>
<td>6.932</td>
<td>0.098</td>
</tr>
<tr>
<td>543</td>
<td>46.68</td>
<td>43.40</td>
<td>61.91</td>
<td>6.640</td>
<td>0.110</td>
</tr>
<tr>
<td>544</td>
<td>44.83</td>
<td>44.00</td>
<td>65.99</td>
<td>6.988</td>
<td>0.075</td>
</tr>
<tr>
<td>551</td>
<td>43.79</td>
<td>44.17</td>
<td>67.36</td>
<td>5.847</td>
<td>0.022</td>
</tr>
<tr>
<td>552</td>
<td>46.09</td>
<td>44.45</td>
<td>71.95</td>
<td>7.009</td>
<td>0.147</td>
</tr>
<tr>
<td>553</td>
<td>46.62</td>
<td>45.12</td>
<td>71.33</td>
<td>7.449</td>
<td>0.094</td>
</tr>
<tr>
<td>554</td>
<td>49.66</td>
<td>47.99</td>
<td>76.00</td>
<td>8.398</td>
<td>0.111</td>
</tr>
<tr>
<td>556</td>
<td>53.37</td>
<td>50.27</td>
<td>74.52</td>
<td>7.462</td>
<td>0.058</td>
</tr>
<tr>
<td>562</td>
<td>55.65</td>
<td>51.91</td>
<td>76.96</td>
<td>8.880</td>
<td>0.018</td>
</tr>
<tr>
<td>563</td>
<td>57.33</td>
<td>52.72</td>
<td>74.70</td>
<td>8.901</td>
<td>0.045</td>
</tr>
<tr>
<td>564</td>
<td>60.49</td>
<td>54.79</td>
<td>81.08</td>
<td>9.838</td>
<td>0.060</td>
</tr>
<tr>
<td>571</td>
<td>61.02</td>
<td>56.10</td>
<td>79.65</td>
<td>8.282</td>
<td>0.088</td>
</tr>
<tr>
<td>572</td>
<td>60.34</td>
<td>56.40</td>
<td>80.94</td>
<td>9.590</td>
<td>0.082</td>
</tr>
<tr>
<td>573</td>
<td>57.16</td>
<td>56.12</td>
<td>79.62</td>
<td>9.357</td>
<td>0.034</td>
</tr>
<tr>
<td>574</td>
<td>53.18</td>
<td>56.30</td>
<td>79.83</td>
<td>9.733</td>
<td>0.058</td>
</tr>
<tr>
<td>581</td>
<td>48.13</td>
<td>55.22</td>
<td>72.49</td>
<td>7.325</td>
<td>0.056</td>
</tr>
<tr>
<td>582</td>
<td>45.06</td>
<td>53.22</td>
<td>74.59</td>
<td>7.761</td>
<td>0.142</td>
</tr>
<tr>
<td>583</td>
<td>43.69</td>
<td>52.11</td>
<td>76.19</td>
<td>7.427</td>
<td>0.102</td>
</tr>
<tr>
<td>584</td>
<td>43.58</td>
<td>53.00</td>
<td>81.86</td>
<td>8.013</td>
<td>0.012</td>
</tr>
<tr>
<td>591</td>
<td>44.01</td>
<td>54.59</td>
<td>80.70</td>
<td>6.905</td>
<td>0.111</td>
</tr>
<tr>
<td>592</td>
<td>47.24</td>
<td>55.76</td>
<td>88.37</td>
<td>8.323</td>
<td>0.102</td>
</tr>
<tr>
<td>593</td>
<td>46.98</td>
<td>55.80</td>
<td>83.14</td>
<td>8.321</td>
<td>0.139</td>
</tr>
<tr>
<td>594</td>
<td>47.85</td>
<td>57.88</td>
<td>85.62</td>
<td>8.994</td>
<td>0.045</td>
</tr>
<tr>
<td>601</td>
<td>48.13</td>
<td>60.10</td>
<td>85.70</td>
<td>7.890</td>
<td>0.006</td>
</tr>
<tr>
<td>602</td>
<td>46.28</td>
<td>60.53</td>
<td>88.09</td>
<td>9.280</td>
<td>0.112</td>
</tr>
<tr>
<td>603</td>
<td>44.50</td>
<td>60.49</td>
<td>84.85</td>
<td>8.980</td>
<td>0.026</td>
</tr>
<tr>
<td>604</td>
<td>44.68</td>
<td>60.38</td>
<td>86.99</td>
<td>9.530</td>
<td>0.009</td>
</tr>
<tr>
<td>611</td>
<td>42.85</td>
<td>61.30</td>
<td>82.59</td>
<td>7.570</td>
<td>0.012</td>
</tr>
<tr>
<td>612</td>
<td>42.72</td>
<td>60.86</td>
<td>89.85</td>
<td>8.610</td>
<td>0.032</td>
</tr>
<tr>
<td>613</td>
<td>42.79</td>
<td>61.12</td>
<td>88.83</td>
<td>8.650</td>
<td>0.066</td>
</tr>
<tr>
<td>614</td>
<td>47.40</td>
<td>62.80</td>
<td>95.15</td>
<td>9.540</td>
<td>0.079</td>
</tr>
<tr>
<td>621</td>
<td>48.20</td>
<td>64.52</td>
<td>92.83</td>
<td>8.020</td>
<td>0.128</td>
</tr>
<tr>
<td>622</td>
<td>49.20</td>
<td>65.20</td>
<td>99.05</td>
<td>9.480</td>
<td>0.050</td>
</tr>
</tbody>
</table>
(1) Bank loan rate. \( (r) \). The data are an average of bank rates on short-term business loans as reported in nineteen large cities. The rate is for loans which range in size from one hundred to two hundred thousand dollars. It is reported for March, June, September, and December and is based in new loans and renewals for the first fifteen days of the months. Source: Federal Reserve Bulletin.

(2) Yield on three month bills. \( (r) \). Data are market yields for the last month of the quarter. Source: Federal Reserve Bulletin and certain unpublished data made available by the Federal Reserve.

(3) Discount rate. \( (r) \). Rate set by the Federal Reserve Bank of New York prevailing on the last day of the quarter. Source: Federal Reserve Bulletin.

(4) Yield on long term U.S. Government bonds. \( (r) \). The series includes bonds as follows: beginning April, 1953, fully taxable marketable bonds due or callable in ten years or more; from April, 1952, through March, 1953, fully taxable marketable bonds due or first callable after twelve years; prior thereto, bonds due or callable after fifteen years. Data are for the last month of the quarter. It should be noted that beginning with April, 1953, figures were computed on the basis of closing bid quotations on the over-the-counter market, while prior to that they were computed on the basis of the mean of the closing bid and asked quotations. Source: Federal Reserve Bulletin.

(5), Privately owned marketable U.S. securities. \( (SH, LO) \). The data are based on the Treasury Survey of Ownership giving the ownership of marketable securities by maturity and type of holder. The data used exclude securities held by U.S. Government agencies and trust funds. \( SH \) measures securities maturing within five years and \( LO \) measures the volume of securities whose current time to maturity exceeds five years. Both variables are measured in billions and are reported for the last month of the quarter. [It should be noted that beginning with the September, 1963, issue of the Federal Reserve Bulletin the basis for classifying bonds with optional call dates was altered from a first call to a final maturity date.] Source: Treasury Bulletin and the Federal Reserve Bulletin.
Bank asset data - general comments. Noncountry bank data are the sum of central reserve city and reserve city data. Commencing with the third quarter of 1962, the central reserve city classification was eliminated although New York and Chicago data are still separately available. All of the asset figures presented above are constructed by dividing the level of bank holdings of the particular asset by the level of net demand deposits, i.e., demand deposits against which member banks are required to hold reserves. There were several changes in the method of reporting the net demand deposit series. Until September, 1952, the data were reported as an average of daily figures covering one-half of a calendar month. For this period, the figure reported above is the average for the second half of the last month of the quarter. Beginning with October, 1952, and up until December, 1959, the data used were monthly averages of daily figures for the last month of the quarter. Beginning with the first quarter of 1960, a four week average of daily figures was reported, and the figure used for this study is for the period ending nearest the termination of the quarter. Net demand deposits, in calculating the asset ratios, were measured in billions of dollars and were in seasonally unadjusted form (as were all the numerator asset figures).

(7), Excess reserve-net demand deposit ratios \( \frac{E^N}{D^N}, \frac{E^C}{D^C} \)
(8) (for noncountry and country banks, respectively.) Excess reserves used in the above ratios were measured in millions of dollars and were dated as of the last month of the quarter. Source: Federal Reserve Bulletin.

(9), Borrowing-net demand deposit ratios. \( \frac{B^N}{D^N}, \frac{B^C}{D^C} \)
(10) (for noncountry and country banks, respectively). Borrowings used in the above ratios were measured in millions of dollars and were dated as of the last month of the quarter. Source: Federal Reserve Bulletin.

(11), Short term security-net demand deposit ratios \( \frac{S^N}{D^N}, \frac{S^C}{D^C} \)
(12) (for noncountry and country banks, respectively). Short term securities are defined as the sum of holdings of bills and certificates by the respective bank classes, and they are measured in millions of dollars. The data are reported as of the quarterly call dates which generally, although not always, fall near the final day of the quarter. Source: Federal Reserve Bulletin.
Long term security-net demand deposit ratios \((O^N/D^N, O^C/D^C)\)

(14) For noncountry and country banks, respectively. Long term securities are defined as the sum of holdings of notes and bonds. The data are measured in millions of dollars and are reported as of the quarterly call dates. Source: Federal Reserve Bulletin.

Gross National Product \((Y)\). Data are quarterly totals in billions of current dollars and are unadjusted for seasonal variation. Source: U.S. Income and Output, Table 1-4, and various issues of the Survey of Current Business.

Money Stock \((M)\). The money supply is defined as demand deposits adjusted in commercial banks plus currency in the hands of the public. The data are in seasonally unadjusted form and measured in billions of dollars. They are for the last half month of the quarter, and the series used was the latest revision appearing in the following: Source: Federal Reserve Bulletin for August, 1962.

Exogenous Expenditure \((E)\). For purposes of this model exogenous expenditure is defined as the sum of total exports, government expenditures at all levels, and an exogenous investment category. This last named is in turn defined as gross private domestic investment less business plant and equipment investment (series 25) and inventory investment (the first difference of series 23). Source: U.S. Income and Output, Table 1-4, and various issues of the Survey of Current Business.

Potential Deposits \((D^*)\). The variable is defined on page 46 of the text above and in turn depends on the following variables: ratio of demand deposits to total deposits for member banks; ratio of total deposits to member bank deposits; total member bank reserves; quarterly average reserve requirement against demand deposits; and quarterly average reserve requirement against time deposits. These variables can be derived from data appearing in various issues of the Federal Reserve Bulletin. The potential deposits series, however, has been previously computed by DeLeeuw and hence was taken from the following: Source: DeLeeuw, [16], Appendix A.

Potential Deposit-Net Demand Deposit ratios \((D^*/D^N, D^*/D^C)\)

(20) For noncountry and country banks, respectively. For purposes of this calculation both deposit variables were measured in billions of dollars. Source: DeLeeuw, [16], Appendix A and various issues of the Federal Reserve Bulletin.
(21) Commercial Loan Demand (ACL). Data are the first differences of the outstanding volume of loans of weekly reporting member banks and are measured in billions of dollars. Until the fourth quarter of 1955 the data were reported in an aggregate category containing commercial, industrial, and agricultural loans. Commencing with the first quarter of 1956, agricultural loans were reported separately, but the figures were summed to create a homogeneous series. In 1959 there was a major revision of the loan schedule which is described in the Federal Reserve Bulletin for August, 1959, and January, 1960. Consequently, beginning with the third quarter of 1959 the data reported above are the sum of commercial and industrial loans, agricultural loans, and loans to nonbank financial institutions. The data are for the last month of the quarter until the revision and for the last week of the quarter following the change. Source: Federal Reserve Bulletin.

(22) Manufacturers' Unfilled Orders. ($U_{t-1}$). (lagged one quarter). The data are seasonally unadjusted figures in billions of current dollars and are reported for the end of the last month of the quarter. The data used refer to total durable goods industries. Source: U.S. Business Statistics, for various years and selected issues of the Survey of Current Business.

(23) Stock of Manufacturers' Inventory. ($I$). The data are quarterly figures in billions of current dollars and are unadjusted for seasonal variation. The basic data appear in SEC-FTC Quarterly Financial Reports which give data on all classes of manufacturing corporations. The series presented was adjusted for sample revisions, and the adjusted series was taken from the following: Source: Meyer and Kuh, [39], Appendix, Table I-B.

(24) Manufacturers' Sales. ($S$) The comments for series (23) apply here also. Source: Meyer and Kuh, [39], Appendix, Table I-A.


(26) Relative Peak Output ($Y_{t-1}^F/Y_t^F$), Relative Capacity Output ($Y_{t-1}^F/Y_t^F$). The series were constructed from data on seasonally adjusted gross national product in current
dollars in accordance with the formulae given on page 121-2 of the text. It should be noted that the denominator $\overline{Y}_t$, was computed using quarterly totals while the numerators were based on annual rates. Source: U. S. Income and Output and various issues of the *Survey of Current Business*. 


[57] Turner, Robert C., "Member-Bank Borrowing", Columbus: Ohio State University, 1938.


BIOGRAPHICAL NOTE

The author, Stephen Michael Goldfeld, was born in Bronx, New York, on August 9, 1940. He attended Harvard College from 1956 to 1960 and received the A.B. degree in mathematics in June, 1960.

He began graduate study at the Massachusetts Institute of Technology in September, 1960, as the holder of the Rand Fellowship in Mathematical Economics. The doctoral thesis was completed at MIT during the tenure of a Ford Foundation Dissertation Fellowship in 1962-63.

The author was married to the former Laura Heend on July 1, 1962. They are the parents of a daughter, Melanie Dawn, born on May 22, 1963.

In September, 1963, he will become an Assistant Professor of Economics at Princeton University, Princeton, New Jersey.