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An explanation of the behavior of the ratio of time deposits to demand deposits

Charlotte Emma Ruebling
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An explanation of the behavior of the ratio
of time deposits to demand deposits

by

Charlotte Emma Ruebling

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of
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CHAPTER I.

INTRODUCTION

Purpose

This dissertation is an examination of the behavior of the ratio of commercial bank time and savings deposits to demand deposits (the t-ratio). It presents and estimates a model which is tentatively held to explain changes in the t-ratio. A particular purpose is to evaluate the importance of changes in income, relative yields and bank reserves in the determination of the t-ratio.

The approach used in constructing the model takes into account the fact that time and savings deposits include three categories of accounts, each with some characteristics which distinguish it from the other two. The three categories are (1) negotiable certificates of deposit (CDs) in denominations of \$100,000 or more, (2) passbook savings accounts, and (3) time deposits other than large negotiable CDs and savings deposits. Their distinguishing features will be discussed later in the paper. The model explaining the behavior of the t-ratio, then, is actually the combination of three equations -- one to explain the behavior of the ratio of large negotiable CDs to demand deposits (n-ratio), one to explain the behavior of the ratio of savings deposits to demand deposits (s-ratio), and one to explain the behavior of the ratio of other time deposits to demand deposits (a-ratio).

$$(1.1) \quad t = n + s + a$$

Certain estimation results are hypothesized as implications of the theory presented in Chapter II and a set of assumptions or initial conditions.¹ If the model is successful, that is, if the estimated equations explain the behavior of the t-ratio and its components under the conditions specified, the procedure would yield more information about the responsiveness of the t-ratio to regulatory changes and other economic conditions which are designed, or expected, to affect primarily the growth of one segment of time and savings deposits than a model used to predict the t-ratio without taking special account of the separate components of time and savings deposits.

Motivation

The t-ratio and the money supply process

Interest in the t-ratio stems from interest in the determination of the money stock and the fact that the t-ratio is usually specified as one of the parameters in the determination of the money stock.² This can

¹Initial conditions here are regarded as the state of factors which could affect the behavior of the variable under study but could be assumed not to have been instrumental in the estimation period. More generally, initial conditions consist of statements which define the conditions in which a theory applies. See Ernst Nagel, The Structure of Science: Problems in the Logic of Scientific Explanation (New York: Harcourt, Brace & World, Inc., 1961), p. 32.

²Economists' interest in the relationship between time deposits and demand deposits also results from concern for selecting the appropriate measure of the money stock. The stock of currency plus demand deposits in the hands of the public is widely regarded as the measure of the money stock. However, there has been the suggestion to include financial assets that are close substitutes for demand deposits and currency. See, for example, John G. Gurley and Edward S. Shaw, Money in a Theory of Finance (Washington, D.C.: The Brookings Institution, 1960). This suggestion has led to empirical studies of substitutability among demand deposits, time deposits, and other financial assets. These studies are

be illustrated with a typical money supply function. The money stock can be specified as a multiple of the sum of bank reserves and currency, as in the equation,

$$(1.2) \quad M = mB,$$

where M = the money stock consisting of demand deposits and currency held by the public, m = the multiplier, and B = the monetary base which consists of bank reserves and currency.³ The value of the multiplier is determined by behavioral and institutional factors which influence the relationship between the source base and the money stock. The multiplier, m , in (1.2) can be described by the equation,

$$(1.3) \quad m = \frac{1 + k}{r(1 + t + g) + k},$$

where k is the ratio of currency held by the public to demand deposits held by the public, t is the ratio of time deposits to demand deposits held by the public, g is the ratio of U.S. Treasury deposits in commercial banks to demand deposits held by the public, and where r represents the ratio of reserves to deposits. The ratios crudely summarize behavioral relations.⁴

pertinent to the empirical investigation of the behavior of the t -ratio and will be cited later.

³The monetary base is one of a number of aggregates that can be called high-powered money. Other measures of high-powered money are the source base and the net source base. The net source base refers to the source base minus member bank borrowings from Federal Reserve Banks. The monetary base, also called the extended base, includes an adjustment to the source base to incorporate reserves in effect liberated or impounded by changes in Federal Reserve required reserve ratios or shifts in deposits among banks which alter the average required reserve ratio on demand or time deposits.

⁴A mechanistic approach to money stock determination, much as I have described, has been criticized by James Tobin and others. Tobin asserts

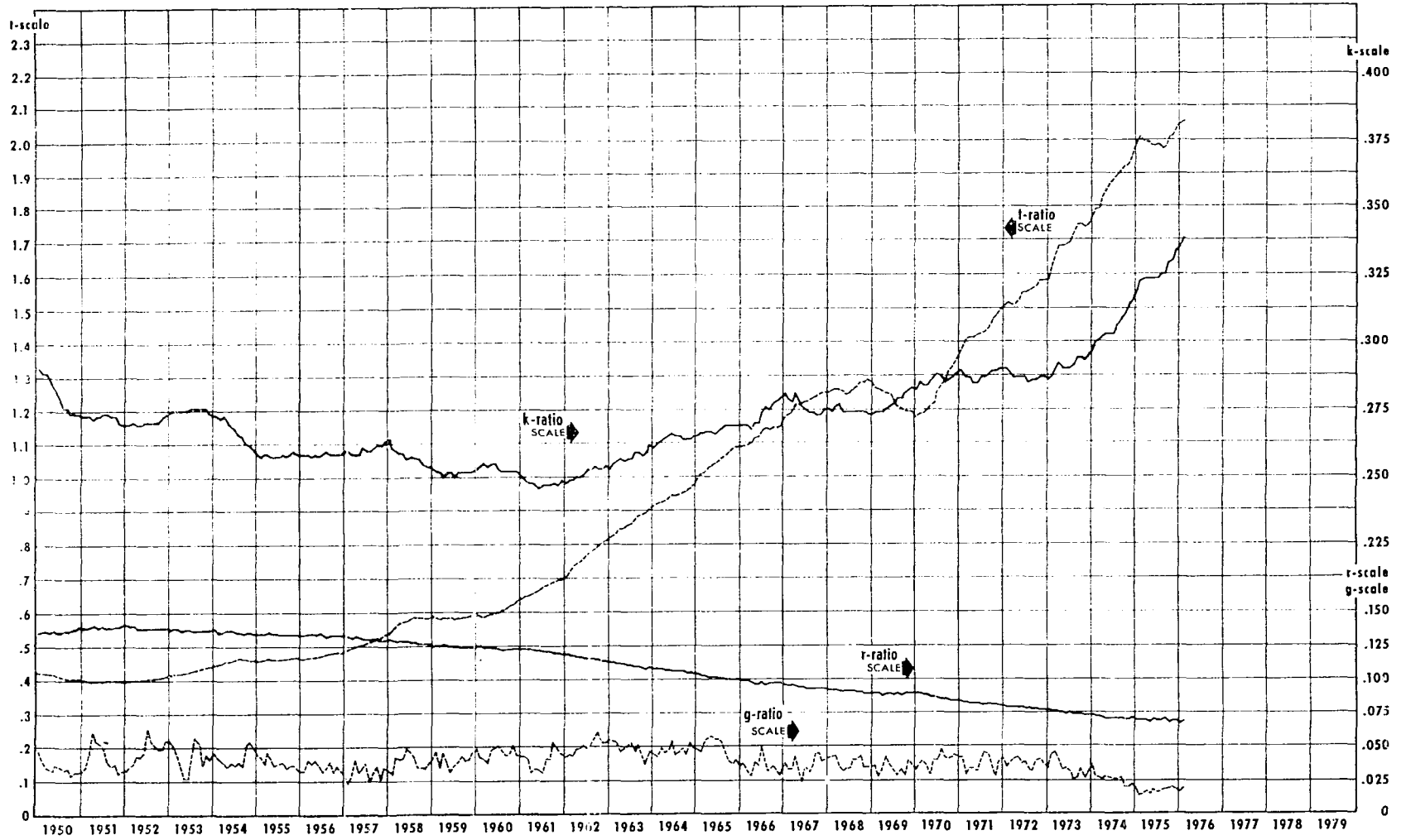
Since 1950, the t-ratio has risen, on balance from about 0.4 to about 2.0 (see Figure 1). Month-to-month changes in the t-ratio have been as large as 0.06, with the average monthly change equal to 0.005. Quarter-to-quarter and year-to-year changes, of course, have been larger.

It can be noted from (1.3) that an increase in the t-ratio, if unaccompanied by changes in other ratios in the multiplier, will have a negative effect on the multiplier and the money stock. However, a change in the t-ratio is likely to be accompanied by a change in one or more of the other parameters of the multiplier. For example, if a change in the t-ratio involves a change in demand deposits, the k- and g-ratios will also change, barring precisely compensating changes in currency and government deposits necessary to leave those ratios unchanged. The r-ratio, in addition, is likely to be affected if there is a shift in time deposits relative to demand deposits but no off-

that in the "old view" of money stock determination the preferences of the public play no role in determining the quantity of money. See James Tobin, "Commercial Banks as Creators of Money," in Banking and Monetary Studies, ed. Deane Carson (Homewood, Ill.: Richard D. Irwin, Inc., 1963), p. 408. In the hypotheses of money stock determination developed by Karl Brunner, Allan Meltzer, and others, which are the bases of equations (1.2) and (1.3), however, public preferences do play a role. Their approach goes beyond equations (1.2) and (1.3) to suggest the determinants of behavior that result in given values for the ratios. A useful summary of the Brunner-Meltzer approach to money stock determination can be found in Albert E. Burger, The Money Supply Process (Belmont, Calif.: Wadsworth Publishing Company, Inc., 1971). At issue still, however, is how consistently the behavior of the ratios can be explained empirically by preferences of the public which can be presumed to be determined by theoretically pertinent variables.

The determination of bank credit and other measures of the money stock, such as one including time deposits, can also be specified by a relation similar to (1.2). The multiplier will, of course, have a specification different from (1.3). However, the t-ratio is a parameter in those relations also. See Burger, The Money Supply Process, pp. 27-31, for specification of these other two multipliers.

Figure 1. Monetary Multiplier Ratios



setting change in total reserves. The r-ratio is dependent on a number of factors, including legal required reserve ratios for members of the Federal Reserve System, the distribution of deposits between member banks and non-member banks, and the demand for excess reserves by commercial banks.⁵ Changes in the public's preference for time deposits relative to demand deposits will affect the r-ratio primarily because required reserve ratios specified in Federal Reserve Regulation D have been lower for time deposits than for demand deposits. Even in the absence of reserve requirements, however, banks could be expected to hold reserves in greater proportion to deposits payable on demand than to time deposits.

In actuality, the t-ratio cannot change while holding everything else in the money supply process constant. Nonetheless, the sensitivity of the multiplier to changes in the t-ratio can be illustrated even while taking the interrelations into account. Following a set of hypothetical, but not atypical, data for parameters of the money supply process are two illustrations of the effects of a change in the t-ratio. The two illustrations vary in assumptions about accompanying changes necessary to sustain the accounting identities (1.2) and (1.3).

Effects of a change in the t-ratio on the multiplier

Assume the following:

Demand deposits in the hands of the public (DD) = \$220 billion

Currency in the hands of the public (C) = \$71.5 billion

Government deposits in commercial banks (G) = \$3.8 billion

⁵For a more complete discussion of factors influencing the r-ratio, see Burger, The Money Supply Process, pp. 45-73.

Time and savings deposits (TD) = \$450 billion

Average reserve ratio for demand and government deposits (r_{DD}) = .13

Average reserve ratio for time and savings deposits (r_{TD}) = .036

Reserves (R) = \$45.29 billion

There are no excess reserves or borrowed reserves.

These conditions produce the following values for the variables in (1.2) and (1.3).

$$M = \$220 \text{ billion} + \$71.5 \text{ billion} = \$291.5 \text{ billion}$$

$$B = \$45.29 \text{ billion} + \$71.5 \text{ billion} = \$116.79 \text{ billion}$$

$$m = \frac{\$291.5 \text{ billion}}{\$116.79 \text{ billion}} = 2.496$$

$$r = \frac{\$45.29 \text{ billion}}{\$673.8 \text{ billion}} = .0672$$

$$k = \frac{\$71.5 \text{ billion}}{\$220 \text{ billion}} = .3250$$

$$t = \frac{\$450 \text{ billion}}{\$220 \text{ billion}} = 2.0454$$

$$g = \frac{\$3.8 \text{ billion}}{\$220 \text{ billion}} = .0173$$

$$\bar{m} = \frac{1 + .325}{.0672(1 + 2.0454 + .0173) + .325} = \frac{1.325}{.5308} = 2.496$$

Case I The t-ratio falls to 2.0, with r_{TD} , r_{DD} , B, R, C, and G unchanged. In this case both TD and DD change as do all the ratios in the multiplier. TD and DD are determined from the relations,

$$(1.4) \quad (r_{DD})DD + (r_{DD})G + r_{TD}(DD) = R,$$

$$(1.5) \quad TD = tDD.$$

Substituting known values for the variables r_{DD} , r_{TD} , G, and R and

solving simultaneously yields $DD = \$221.76$ billion and $TD = \$443.52$ billion.⁶ The remaining ratios in the multiplier become $k = .3224$, $g = .0171$, $r = .0677$. As a result the multiplier increases to 2.511. This change in the multiplier produces a \$1.76 billion rise in the money stock.

Case II The t-ratio again falls to 2.0. In this case, R , r_{TD} , and r_{DD} remain unchanged, as in Case I. However, unlike Case I, the k- and g-ratios also remain unchanged, while B, DD, TD, G, C, and the r-ratio are all allowed to change. Calculation of the values of these variables makes use of relations (1.4) and (1.5) in addition to the following.

$$(1.6) \quad G = gDD$$

$$(1.7) \quad C = kDD$$

The assumptions for this case produce the following changes. DD rises to \$221.79 billion and TD falls to \$443.58 billion, approximately the same as in Case I. The r-ratio rises to .0677. In order for the k- and g-ratios to remain unchanged, C must rise to \$72.08 billion and G to \$3.84 billion. In turn, B must be allowed to rise by as much as the rise in C. With these conditions, $m = 2.503$. The increase in the multiplier is less than in Case I because the positive effects of declines in the k- and g-ratios, present in Case I, are not allowed to occur.

The effects of a rise in the t-ratio on the multiplier could also be worked out. For example, if the t-ratio rose to 2.075, accompanied by the conditions assumed in Case II, the multiplier would fall to

⁶Details of calculations for Case I and Case II are shown in Appendix A.

2.491.⁷ With a monetary base of \$116.79 billion, this would produce a decline in money stock of about \$590 million, from the initial level of \$291.5 billion.

These illustrations indicate that when there is a change in the t-ratio, the r-ratio changes so as to have an effect opposite to that of the change in the t-ratio on the multiplier. However, the changes are not completely offsetting. One way to describe the effect of a rise in the t-ratio is to say that time deposits are absorbing a greater part of the monetary base, or are reducing the portion of the monetary base available to support the money stock.

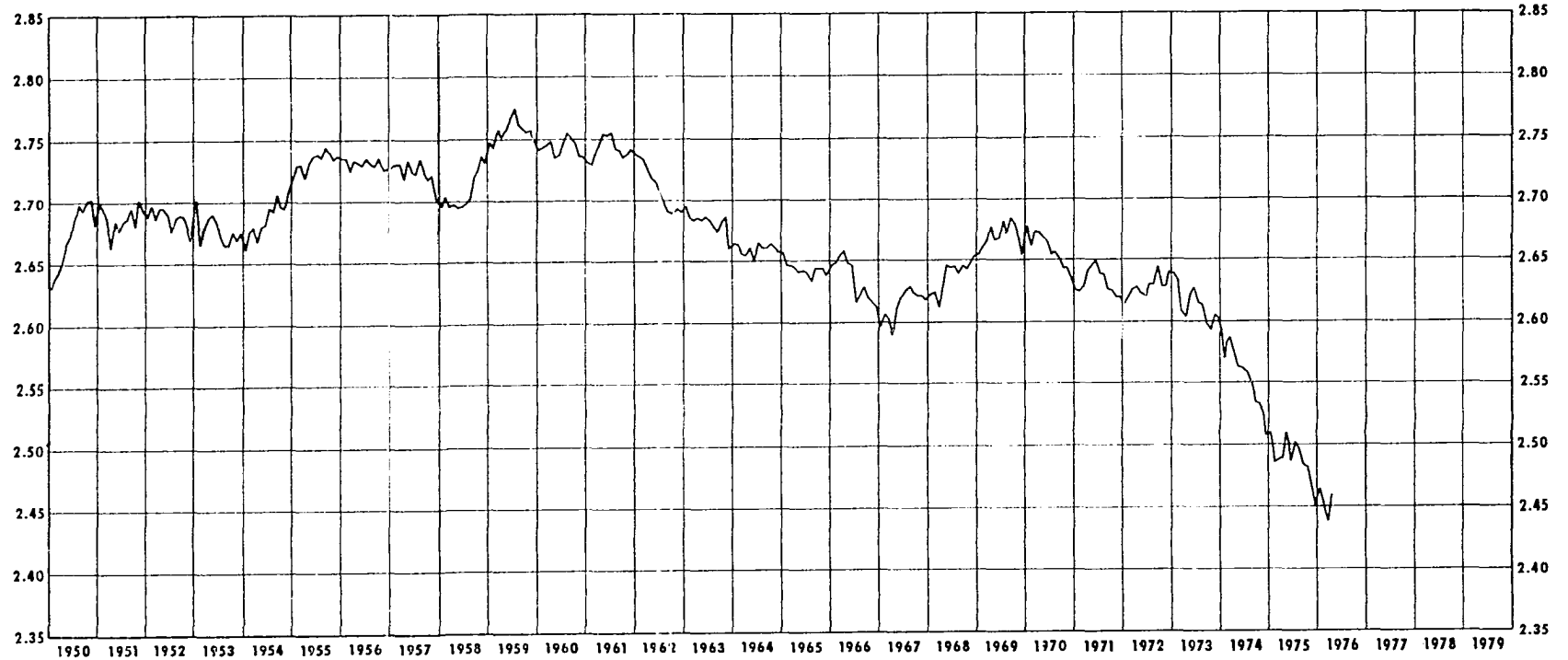
Simple observation suggests that changes in the t-ratio have significantly affected the multiplier. From 1950 to 1960, the main movements of both the multiplier and the t-ratio were upward; other factors affecting the multiplier more than offset the negative impact of a rise in the t-ratio from about 0.4 to 0.6. Since 1961, however, there has been approximately a fourfold increase in the t-ratio and the multiplier has trended downward (see Figures 1 and 2).

Components of the t-Ratio

Categories within the time and savings deposit classification can be used to segment the t-ratio. Various sub-groupings of time and savings deposits are defined in the Federal Reserve System's Regulation Q. Over the years there has been a proliferation of these sub-groupings and the specification of types of accounts has increased in detail. Regulation Q distinguishes among types of deposits on the basis of size, maturity, and

⁷ See Case II' in Appendix A.

Figure 2. Monetary Multiplier*



*The monetary multiplier is defined as the money stock divided by the monetary base. Data are seasonally adjusted.

contractual arrangements for payment of interest and withdrawal, as well as the characteristics of the holder -- for example, whether the holder is an individual, a profit or nonprofit corporation, a governmental unit, or a foreign body.⁸ The three main classifications of time and savings deposits in Regulation Q are (1) savings deposits, (2) time certificates of deposit, and (3) time deposits - open account.

Savings deposits are interest earning accounts with no precise amounts or maturities specified in the contract between the bank and the depositor except that the bank may require the depositor to give notice of intended withdrawal 30 days in advance of the withdrawal. A savings account typically is evidenced by a passbook which records deposits and withdrawals as well as interest payments. Until November 1975, corporations operated for profit were not allowed to hold savings deposits. At that time, Regulation Q was amended to allow such corporations to hold a savings deposit of up to \$150,000 at a member bank.

Time certificates of deposit and time deposits - open account involve an agreement between bank and depositor that is more specific with regard to either amount or maturity, or both, than is the case with savings deposits. Time certificates are evidenced by a negotiable or non-negotiable instrument and may have a single maturity or be renewable. Time deposits - open account involve a specified contract, but do not in-

⁸ See Federal Reserve Regulation Q. For additional information about sub-groupings of time and savings deposits, see the table entitled "Maximum Interest Rates Payable on Time and Savings Deposits," in the Federal Reserve Bulletin 62 (February 1976):A8. See also the reports of periodic surveys published in the Bulletin, for example, John R. Williams and Virginia Lewis, "Changes in Time and Savings Deposits at Commercial Banks, January-April 1975," Federal Reserve Bulletin 61 (October 1975):618-24.

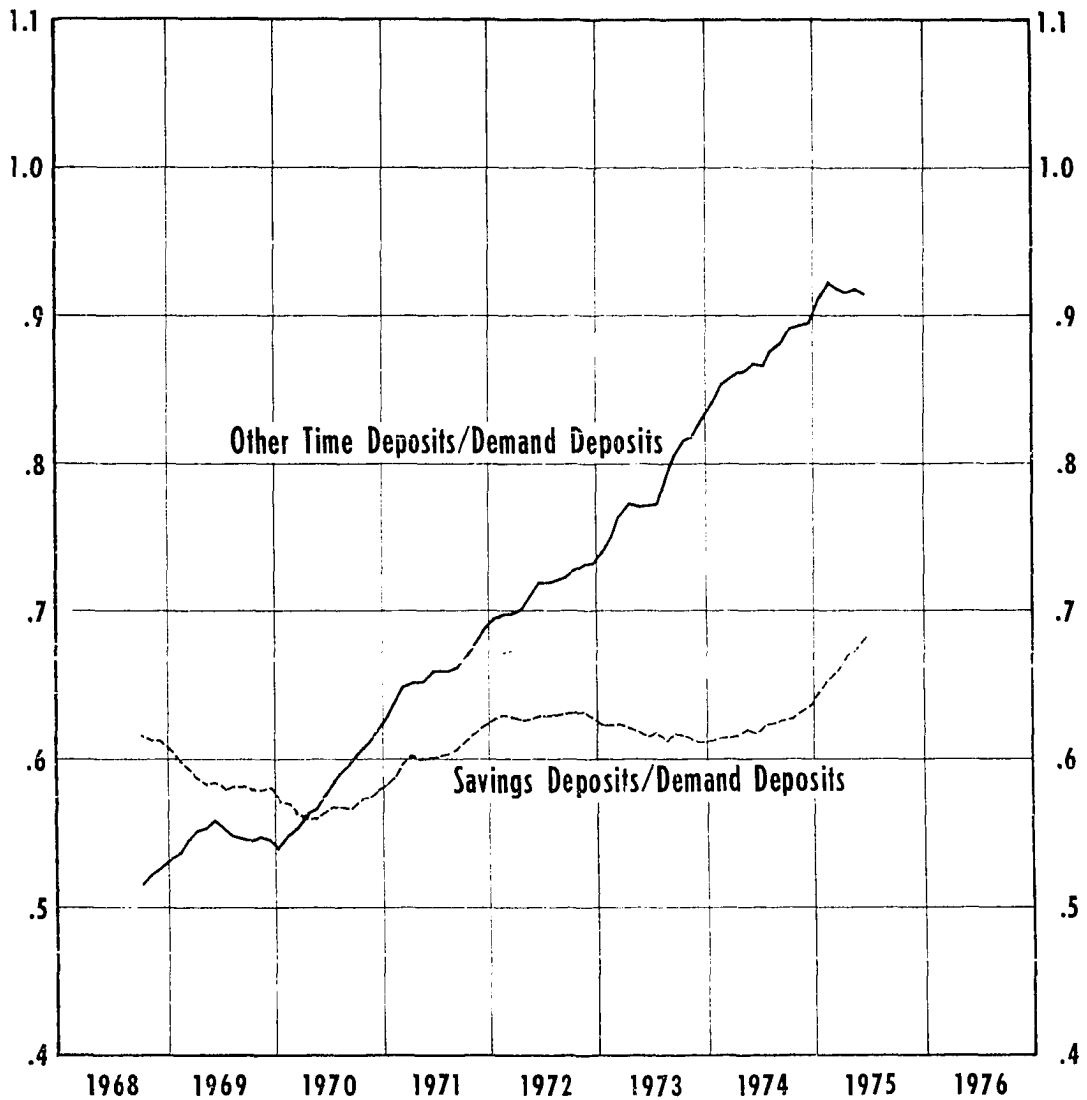
volve a certificate. A Christmas Club account is an example within the classification time deposit - open account.

For the purpose of examining determinants of the t-ratio, it is useful to classify time and savings deposits somewhat differently than just discussed. For this purpose it is useful to distinguish among types of deposit because they vary with respect to determinants of supply and demand or in historical behavior. On this basis time and savings deposits can be broken into the following categories: (1) savings deposits, (2) negotiable CDs in denominations of \$100,000 or more, and (3) smaller CDs and time deposits - open account (which will be referred to as "other time deposits").

Savings deposits generally have been regarded as the repository for relatively long-term savings accumulated in relatively small amounts. Data for savings deposits on a daily average basis for member banks are available back to 1968. The ratio of savings deposits to demand deposits since then has changed relatively little (see Figure 3 and Appendix B). One could surmise that on the demand side the growth of savings deposits is influenced by income and seasonal factors.⁹ Demand for savings deposits is probably less sensitive to changes in yields than are other classifications of time and savings deposits. Nonetheless, savings and loan and credit union shares, savings bonds and perhaps other financial assets might be regarded as substitutes for savings deposits, meaning the yields on those assets are factors affecting the demand for savings deposits. Characteristics of savings deposits and determinants

⁹Savings deposit data used to compute ratios charted in Figure 3 have been seasonally adjusted.

**Figure 3. Ratios of Savings Deposits
and Other Time Deposits to Demand Deposits***



*Other time deposits consist of total time and savings deposits minus large negotiable CDs and savings deposits. Data are seasonally adjusted.

Prepared by Federal Reserve Bank of St. Louis

of the ratio of savings deposits to demand deposits will be discussed further in Chapter III.

Negotiable CDs in denominations of \$100,000 or more comprise a category of financial assets with demand and supply characteristics much different from savings deposits as well as a divergent historical pattern of behavior.¹⁰ Large negotiable CDs have been observed as a distinct class of deposits in monetary data since 1961. At that time First National City Bank began to offer CDs in the amount of \$1 million or more to corporations as well as to individuals. At the same time Discount Corporation of New York began trading in large CDs so that they became marketable as well as technically negotiable. Soon other banks also began issuing large negotiable CDs.¹¹ Large negotiable CDs of commercial banks are competitive with money market instruments such as Treasury bills and commercial paper. They are purchased primarily by large corporations. Other purchasers include state and local governments, trust companies, nonbank financial institutions, foreign central banks and individuals.¹² Since 1961 the ratio of large negotiable CDs

¹⁰ Hereafter, negotiable CDs in denominations of \$100,000 or more will be referred to as large CDs. Most of these are issued by the largest banks and data maintained are for large negotiable CDs at large weekly reporting commercial banks.

¹¹ For a more detailed account of the development of large negotiable CDs as a major money market instrument, see Albert Gilbert Heebner, "Negotiable Certificates of Deposit: The Development of a Money Market Instrument" (Ph.D. dissertation, University of Pennsylvania, 1967).

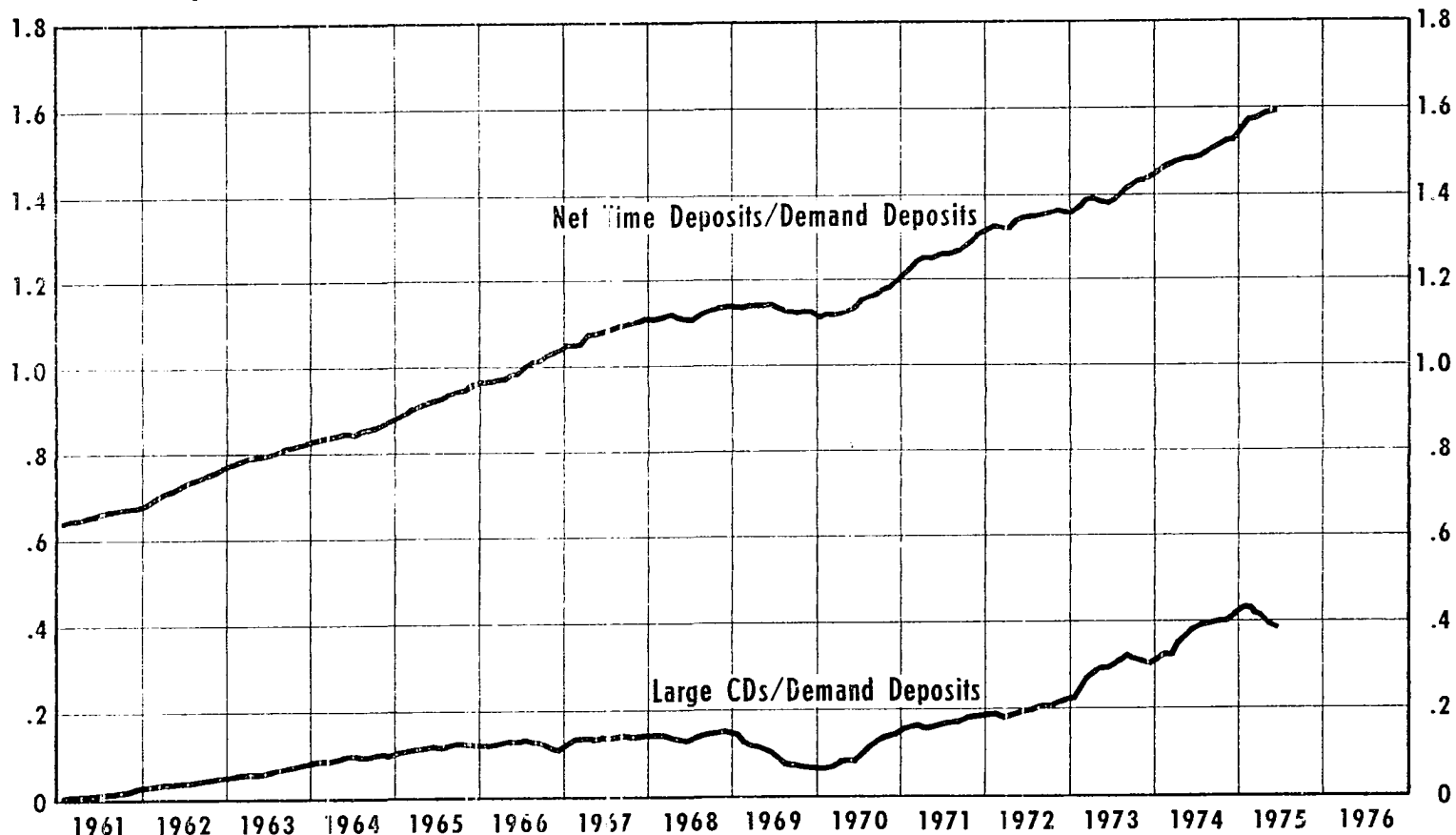
¹² It has been estimated that corporations hold about 70 percent of large CDs outstanding and that state and local governments hold 10 to 15 percent. See Joseph E. Rossman, Jr., "A Study of the Use of Negotiable Certificates of Deposits by Large U.S. Banks to Satisfy Liquidity, Profitability, and Soundness Needs" (Ph.D. dissertation, Iowa State University, 1975), p. 9.

to demand deposits has risen from zero to about 0.4 (see Figure 4). The rising prominence of large CDs appears to account for roughly 30 percent of the rise in the t-ratio since 1961.

Time deposits other than savings deposits and large negotiable CDs include instruments and accounts with varying degrees of similarity to savings deposits and large negotiable CDs. Time certificates in smaller denominations, as low as \$500, and Christmas Club accounts are similar to savings deposits in that they compete primarily for savings of individuals. They differ from savings deposits in being less flexible from the holder's point of view and they generally bear a higher yield. Larger denomination certificates, also held primarily by individuals, nonprofit groups and small businesses, are probably more responsive to changing yields and must compete with Treasury bills and similar financial assets. Expansion in this composite group of time deposits has also contributed significantly to the rise in the t-ratio (see Figure 3).

The selected components of the t-ratio -- the s-ratio, the n-ratio, and the a-ratio -- have all moved upward since 1961. The pace and pattern, however, have varied among them (compare Figures 1, 3, and 4). This along with their characteristic differences suggests that an explanation of the t-ratio might be approached by examining the components.

Figure 4. Ratios of Large Negotiable CDs to Demand Deposits and Net Time Deposits to Demand Deposits*



*Net time deposits consist of total time and savings deposits minus large negotiable CDs at weekly reporting large commercial banks. Data are seasonally adjusted.

Prepared by Federal Reserve Bank of St. Louis

CHAPTER II.

FACTORS EXPECTED TO AFFECT THE t-RATIO

The model, to be presented in Chapter III, is based on the following discussion of factors that could be expected to affect the t-ratio. The discussion draws on earlier studies of the t-ratio as well as on other studies from which information about determinants of the t-ratio can be derived.

Previous Studies and Observations

Historical Observations of Time Deposits and Demand Deposits

A certain amount of insight into the causes of change in the relative magnitudes of time and demand deposits can be obtained by observing their movements over a considerable period and examining events associated with changes.¹ Studies by Phillip Cagan and by Milton Friedman and Anna Schwartz include an examination of the growth paths of several deposit-type financial assets.² Some of the broad movements in relative growth can be summarized as follows.

¹Unless otherwise noted, the term time deposits should be interpreted to mean time and savings deposits.

²Phillip Cagan, Determinants and Effects of Changes in the Stock of Money 1875-1960 (New York: National Bureau of Economic Research, 1965), pp. 164-81; Milton Friedman and Anna Jacobson Schwartz, A Monetary History of the United States 1867-1960 (New York: National Bureau of Economic Research, 1963), pp. 639-75, Monetary Statistics of the United States: Estimates, Sources, Methods (New York: National Bureau of Economic Research, 1970), pp. 154-71.

1. Time deposits increased relative to demand deposits from 1900 through the 1920s.
2. The share of time deposits fell relative to demand deposits in the 1930s and into the early 1940s.
3. In the post-World War II period, time deposits have risen relative to demand deposits.

Cagan and Friedman and Schwartz suggest that supply conditions probably encouraged time deposit growth in the early 1900s. Beginning in 1904 yields on bank assets rose, encouraging banks to compete for funds. In addition, banks had the advantage of offering greater convenience (more services at one location) than mutual savings banks. Lower reserve requirements on time deposits than on demand deposits at national banks after the Federal Reserve Act was passed in 1913 also acted as a stimulus to time deposit growth. Prior to this some states had set lower reserve requirements for time deposits, but at nationally chartered banks reserve requirements on time deposits had been the same as on demand deposits.³ It has also been noted that bankers promoted the transfer of funds from demand to time deposit accounts in the 1920s by allowing checks to be charged against them.⁴

The reversal in relative magnitudes during the 1930s was probably the result of both demand and supply factors. Yields on bank assets declined. This, in combination with the increased uncertainty in the depressed economy increased banks' preference for liquidity relative to earning assets. Consequently, the lower reserve requirements on time

³Cagan, Determinants and Effects, p. 164.

⁴This was done through an extra passbook kept at the bank. Ibid., p. 167.

deposits were less of an inducement to banks to acquire time deposit funds than previously. These conditions resulted in lower offering rates on time deposits and a smaller spread between yields on time deposits and demand deposits.⁵ Response to the reduction in this yield differential probably contributed to the decline in the quantity of time deposits relative to the quantity of demand deposits. In addition, or alternatively, the decline in time deposits relative to demand deposits could have been the result of demand for time deposits being more sensitive than the demand for demand deposits to the decline in income.

The main cause of the rise in the t-ratio since World War II would appear to be the rise in interest rates, and the consequent increase in the spread between yields on time deposits and demand deposits and increased sensitivity to relative yields on the part of holders of financial assets. On an annual basis there has been only one year in this period when the t-ratio declined. That was from 1968 to 1969 and appears to have been due to interest rate ceilings limiting banks' ability to compete for time deposit funds.⁶

The historical studies by Cagan and Friedman and Schwartz draw attention to the fact that the nature of individual categories of financial assets may change over the years due to innovations, changes in regulations, and other developments. Examples of this include the practice of allowing checks to be charged against time deposits in the 1920s and the subsequent prohibition of it, the change in insurance

⁵ Official yields on demand deposits became zero with passage of the Banking Act of 1933 which prohibited interest payments on demand deposits.

⁶ Burger, The Money Supply Process, p. 82.

provisions on savings and loan shares in 1950, and the development of a market for negotiable CDs in the early 1960s. The recent regulatory change permitting corporations operated for profit to hold commercial bank savings deposits alters some economic aspects of savings deposits and could exert a substantial impact on the growth of savings deposits relative to demand deposits since it makes it easier for relatively small businesses to earn interest on funds.

Studies of the t-Ratio

Relatively little published material has been aimed directly at explaining the t-ratio. However, there are numerous theoretical discussions and empirical investigations in the literature that have implications for the t-ratio. The studies which focus directly on the t-ratio are discussed below. Those which have implications for the t-ratio are discussed in the next subsection of this chapter.

In The Money Supply Process Albert E. Burger describes a set of factors that each ratio in the multiplier is hypothesized to depend on and the direction of dependence on each factor. He specifies the following relationship for the t-ratio:⁷

$$(2.1) \quad t = f\left(i^f, i^t, \frac{W}{P}, \frac{Y}{Y_p}\right),$$

where:

i^f = index of yields on financial assets, other than time deposits, traded on the credit market,

i^t = index of banks offering yields on time deposits,

⁷The following discussion is based on *Ibid.*, pp. 73-91.

$\frac{W}{P_a}$ = real value of the stock of nonhuman wealth held by the public,

$\frac{Y}{Y_p}$ = ratio of current to permanent income.

The directions of the relationships are:

$$(2.2) \quad \frac{\partial t}{\partial i^t}, \frac{\partial t}{\partial \left(\frac{W}{P_a}\right)}, \frac{\partial t}{\partial \left(\frac{Y}{Y_p}\right)} > 0 \quad \frac{\partial t}{\partial i^f} < 0$$

Burger has little comment on the response of the t-ratio to changes in wealth or to a change in the relation of current to permanent income, but goes on to discuss in more detail the response of t to changes in interest rates. This response depends on the behavior of banks in setting i^t in response to a change in other interest rates and on the behavior of the public in choosing between demand deposits and time deposits when there are changes in i^f and i^t . The elasticity of t with respect to changes in interest rates $[\eta(t,i)]$ is summarized in the statement:

$$(2.3) \quad \eta(t,i) = [\eta(t,i^f) + \eta(t,i^t) \cdot \eta(i^t,i^f)] \cdot \eta(i^f,i)$$

where:

$\eta(t,i^f)$ = the elasticity of the public's demand for time deposits relative to demand deposits with respect to a change in interest rates on financial assets

$\eta(t,i^t)$ = the elasticity of the public's demand for time deposits relative to demand deposits with respect to a change in interest rates on time deposits

$\eta(i^t,i^f)$ = the elasticity of interest rates on time deposits with respect to a change in interest rates on financial assets

$\eta(i^f,i)$ = a weighting factor.

Burger's analysis contains statements regarding the signs of the elasticities on the right-hand side of (2.3). He postulates that the

first elasticity, $\eta(t, i^f)$, is negative. This is based on the expectation that demands for both demand deposits and time deposits are negatively related to yields on alternative assets and also on the expectation that the substitution between securities and time deposits (T) dominates the substitution between securities and demand deposits (D^P), so that:

$$(2.4) \quad |\eta(T, i^f)| > |\eta(D^P, i^f)|.$$

In other words, when interest rates such as yields on Treasury bills rise, people switch out of time deposits into securities more than out of demand deposits into securities. The relation (2.4) is based on a finding by Jerry L. Jordan that the interest elasticity of demand for time deposits is greater than the interest elasticity of demand for demand deposits.⁸

The second elasticity [$\eta(t, i^t)$] is postulated to be positive on the basis that demand for time deposits is positively related to the yield on time deposits and demand for demand deposits is negatively related to the yield on time deposits.

The third elasticity [$\eta(i^t, i^f)$], representing banks' response to changes in yields is the most interesting. Burger postulates:

$$(2.5) \quad i^t = f(i^f, Q^*),$$

where Q^* represents the Federal Reserve Regulation Q ceilings on interest rates payable on time deposits at member banks.⁹ The response of i^t

⁸Jerry L. Jordan, "The Market for Deposit-Type Financial Assets" (Ph.D. dissertation, University of California, Los Angeles, 1969), pp. 159-66.

⁹The Federal Deposit Insurance Corporation establishes ceiling rates on time deposits at insured nonmember banks. In practice ceiling rates have been the same for both member banks and nonmember banks.

to a change in i^f is positive, but approaches zero as i^t approaches Q^* .

Combining the effects of $\eta(t, i^f)$, $\eta(t, i^t)$ and $\eta(i^t, i^f)$, we see that the total interest elasticity of t depends importantly on Q^* and on the magnitude of $\eta(t, i^f)$ relative to the product of $\eta(t, i^t)$ and $\eta(i^t, i^f)$. If Regulation Q ceilings are effective, preventing a competitive response on the part of banks to a change in yields on financial assets, then $\eta(t, i^t) \cdot \eta(i^t, i^f)$ will approach zero. Then the total interest elasticity of t will be determined by the response of demand for time deposits relative to demand for demand deposits [$\eta(t, i^f)$], and this elasticity is hypothesized to be negative. If Q ceilings are not effective, then the sign of the total elasticity will depend on the relative magnitudes of the absolute values of $\eta(t, i^f)$ and [$\eta(t, i^t) \cdot \eta(i^t, i^f)$].

To summarize, Burger's analysis emphasizes the following as important in the determination of the t -ratio.

1. The determination of i^f
2. banks' behavior in setting i^t
3. relative demand for deposit-type assets.

There are three studies I know of that empirically investigate determinants of the t -ratio.¹⁰ In one, Dwayne Wrightsman hypothesizes that the t -ratio is positively related to income and the interest rate on time deposits and negatively related to the implicit yield on demand

¹⁰Stuart G. Hoffman, "Determination of the Money Multiplier by Component Ratio Estimation" (Ph.D. dissertation, University of Cincinnati, 1975), and paper presented at the meeting of the Federal Reserve System's Committee on Financial Analysis, New York, N.Y., 19-20 November 1975; William R. Hosek, "Determinants of the Money Multiplier," The Quarterly Review of Economics and Business 10 (Summer 1970):37-46; Dwayne Wrightsman, An Introduction to Monetary Theory and Policy (New York: The Free Press, 1971), pp. 60-64.

deposits and interest rates on claims against nonbank financial intermediaries. He also hypothesizes that the relationship between the t-ratio and the yield on primary securities (stocks and bonds) may be positive or negative in that some securities are more substitutable for time deposits than others.

...now that negotiable time certificates of deposit have come on the scene, time deposits may possibly be no less substitutable than cash for Treasury bills and other money market instruments. On the other hand it is doubtful whether the time deposit ratio is inversely related to yields on mortgages and marketable bonds. Institutional cash holders are very sensitive to changes in these yields and respond to them by doing considerable switching in and out of demand deposits, whereas switching between savings deposits and long-term debt issues has not been so much in evidence.¹¹

The empirical model Wrightsman estimates includes only income and the difference between the three-month Treasury bill rate and the maximum rate payable on savings deposits as independent variables. He uses seasonally adjusted monthly data and one-month lags in the independent variables and estimates the equation over two periods, 1957 through 1960 and 1961 through 1965. He views 1957-1960 as a period of "pronounced cyclical activity" and 1961-1965 as a period of steady expansion. His results are as hypothesized over the 1957-1960 period; the t-ratio is positively related to income and negatively related to the interest rate variable. However, over the 1961-1965 period, the t-ratio is positively related to the interest rate variable. With additional information (from an equation using first differences (1957-1960), in which the income coefficient is statistically insignificant and from an equation including

¹¹Wrightsman, An Introduction, pp. 61-62.

a time trend (1961-1965), in which the income coefficient is zero, Wrightsman concludes that income exerts a secular influence on the t-ratio and interest rates exert a cyclical influence.

A second study, one by William R. Hosek, involves empirical analysis of an implicit yield on demand deposits and seasonality, as well as of income and yields on Treasury bills and time deposits. The equation Hosek estimates is:

$$(2.6) \quad t = a_2 + b_{21}[(r_s - r_t)/(r_s + r_{sc})] + b_{22}Y_p + \mu_2,$$

where:

r_s = the market yield on three-month Treasury bills

r_t = the maximum rate payable on time deposits under Regulation Q as a proxy for interest rates on time deposits

r_{sc} = the service charge on demand deposits

Y_p = a permanent income concept

μ_2 = a random error term.

Hosek hypothesizes that b_{21} is negative and b_{22} is positive, and that institutional changes do not exert a significant influence on t . In estimating the equation, he assumes that adjustment between desired and actual values of t takes place within a quarter. He then estimates coefficients using quarterly not seasonally adjusted actual ratios and concurrent values of the independent variables for the period I/1953 through IV/1967. The estimated equation, with coefficients scaled by a factor of 100, is:

$$(2.7) \quad t = -91.169 - 11.552[(r_s - r_t)/(r_s + r_{sc})] + 0.324 Y_p$$

(3.352) (1.304) (0.006)

$$R^2 = .982$$

The coefficients are significant and of the expected sign.¹² He also estimates the t-ratio with an equation including seasonal dummies and concludes that while there is seasonality in both time deposits and demand deposits, seasonal factors do not appear to be of significance in determining the t-ratio.¹³

The third study is by Stuart Hoffman. His study investigates the effects on the t-ratio of inflation and changes in stock prices, as well as the effects of interest rates, income and seasonality. He measures income as nominal gross national product and has a separate equation determining the rate of interest paid on time deposits. His two equations are the following.¹⁴

$$(2.8) \quad t_t = t_t(\text{GNP}_{t-1}, r_{b_t}, r_{t_t}, \Delta\text{CPI}_t, \text{SP}_{t-1}, S_1, S_2, S_3, t_{t-1})$$

$$(2.9) \quad r_{t_t} = r_{t_t}(r_{b_t}, r_{t_t}^{\max}, \text{TDD}_t)$$

where:

GNP = nominal gross national product

r_b = market yield on 90-day Treasury bills

r_t = the average yield on commercial bank time and savings deposits

r_t^{\max} = the weighted average legal maximum rate on time and

¹²The numbers in parentheses are standard errors.

¹³Casual observation of a chart showing not seasonally adjusted t-ratios casts doubt on this conclusion. In addition, Hoffman's study found seasonal dummies to have a significant influence on the t-ratio.

¹⁴Hoffman's dissertation includes a variable for service charges on demand deposits in the t-ratio equation. This variable, however, is not included in the subsequent paper.

savings deposits at commercial banks¹⁵

Δ CPI = annual rate of change in the consumer price index

SP = Standard and Poor's 500 stock price index

S_1, S_2, S_3 = Seasonal Dummy variables

TDD = a dummy variable to capture the June 24, 1970, suspension of ceiling rates on 30-89 day large negotiable certificates of deposit.

GNP is lagged one period on the basis of findings of other studies of time deposits. Stock prices are also lagged one period, based on the notion that the public delays switching between stocks and time deposits until the stock market has shown a sustained increase or decrease.

The ordinary least squares estimation of the reduced form equation using quarterly not seasonally adjusted data for the period I/1960 through IV/1972 is:

$$\begin{aligned}
 (2.10) \quad t_t = & -0.11506 + 0.00002GNP_{t-1} - 0.01247r_{b_t} + 0.03799r_t^{\max} \\
 & (-2.60698) \quad (0.41895) \quad (-4.15862) \quad (4.20221) \\
 & + 0.00883TDD_t - 0.00077SP_{t-1} + 0.03989S_1 + 0.04852S_2 \\
 & (0.70909) \quad (-2.32170) \quad (6.79395) \quad (9.80993) \\
 & + 0.03566S_3 + 0.94121t_{t-1} \\
 & (7.74991) \quad (22.3173) \\
 R^2 = & .9988 \qquad \qquad \qquad S.E.E. = 0.01079
 \end{aligned}$$

In Hoffman's results the change in the CPI was an insignificant determinant of t_t .¹⁶ It might be noted, however, that the effect of

¹⁵ r_t^{\max} is the average of the maximum yield payable on savings deposits and the maximum yield payable on 90-day large CDs, with yields weighted by the proportions of total time and savings deposits in the net time deposit and large CD classifications, respectively.

¹⁶ The numbers in parentheses are t-statistics.

inflation might be included in the coefficients for nominal GNP and interest rates. The negative coefficient for the stock price equation led him to conclude that time deposits are a closer substitute for common stocks than are demand deposits. The seasonal dummies confirm the tendency of t to rise in the first three quarters of the year and fall in the last.

Hoffman also estimates the structural equation using the estimated value \hat{r}_{t_t} from equation (2.9) and two-stage least squares estimation techniques. Coefficients of variables in both the structural and reduced form equations were about the same in both estimations except for the coefficients of the Treasury bill rate. The coefficient of r_{b_t} in the structural equation was 0.02429, or about twice as large as in the reduced form equation. Hoffman notes that the coefficient of r_{b_t} in the reduced form equation includes the effect of r_{b_t} on the rate paid on time deposits. This effect is positive.¹⁷ The coefficient, however, remains negative, though of lower absolute value. He investigates whether the bill rate might have different effects in periods when it is relatively high by breaking the sample period into two subperiods. In the first subperiod — 1960/I-1965/IV and 1971/I-1972/IV — the Treasury bill rate averaged 3.38 percent. In the second — 1966/I-1970/IV and 1973/I-IV, the Treasury bill rate averaged 5.76 percent. The sign of r_{b_t} was found to be negative and significantly different from zero in both cases.

The three studies just discussed all investigate the t -ratio as a

¹⁷Hoffman's estimation of structural equation (2.9) shows r_{t_t} to be positively related to r_{b_t} , as expected.

function of relative interest rates and income. In doing so, they emphasize the choice asset holders make among demand deposits, time deposits, and other financial assets. The estimations produce high R^2 's and signs of coefficients generally are as expected. However, they all use rather crude measures of the yield on time deposits, which would appear to be the variable of most immediate theoretical significance in determining the t-ratio. In many instances, Regulation Q ceilings, used prominently, do represent an appropriate proxy for interest rates paid on time deposits. However, there are numerous ceiling rates in effect for different types of deposit at a given time, whereas Wrightsman uses only the ceiling rate on savings deposits, and it is implied (though not altogether clear) that Hosek uses only the highest ceiling rate. In Hoffman's study the dependent variable (r_t) in his structural equation (2.9) is based on annual interest payment data and time deposit data from the Annual Report of the Federal Deposit Insurance Corporation. The rate, calculated as annual interest payments divided by average time deposits outstanding, is distributed across quarters according to the pattern of time deposits.¹⁸ His measure of Regulation Q involves a weighted average of two ceiling rates.

Studies with Implications for an Explanation of the t-Ratio

Studies not concerned with the t-ratio per se, but which nonetheless can offer insight into factors determining it, are those dealing with models of the financial sector or markets for specific financial assets and those describing bank behavior. Literature concerning these

¹⁸Hoffman, "Determination" (dissertation), p. 174.

topics is voluminous and, of course, contains much that is not directly related to the t-ratio. What will be considered here is only a very small portion of that literature. The discussion will be limited to a brief summary of some results and descriptions of hypotheses and observations which may be employed in developing a model for describing behavior of the t-ratio.

Determinants of demand for various types of financial assets are also likely candidates to be determinants of the t-ratio. Numerous studies have concentrated on the demand for financial assets in order to evaluate income elasticities, own- and cross-price elasticities, and hence the degree of substitutability among them. The empirical studies include time series as well as cross-section analysis of demands for commercial bank time and savings deposits, demand deposits, savings and loan shares, mutual savings bank deposits and securities. Results of different studies regarding the degree of substitutability among different financial assets are not in complete agreement.

Two studies by Edgar Feige using temporal cross-section data over the period 1949-59 failed to confirm the hypothesis that there are important substitution relations among demand deposits, time deposits and other deposit-type assets.¹⁹ He found relatively low cross elasticities. He also found the demand relations to be relatively stable across both what he regarded as tight- and easy-money periods.

¹⁹Edgar L. Feige, The Demand for Liquid Assets: A Temporal Cross-Section Analysis (Englewood Cliffs, N.J.: Prentice Hall, Inc., 1964), and "Alternative Temporal Cross-Section Specifications of the Demand for Demand Deposits," in Issues in Monetary Economics, Proceedings of the 1972 Money Study Group Conference, ed. H. G. Johnson and A. R. Nobay (London: Oxford University Press, 1974), pp. 260-89.

Feige's estimations of demand equations for various financial assets using cross-section data by states assumed that demand functions are linear, that supply is independent of demand, and that demand behavior is determined only by economic conditions in the state of residence. Variables in the demand equations included various yields, permanent per capita income, per capita demand deposits held by individuals, partnerships and corporations and eight dummy variables to account for different financial conditions in different geographic locations. The demand deposit equation also included a variable measuring the proportion of total demand deposits held by individuals. The savings and loan share equation also included a variable measuring per capita advertising expenditures by savings and loan associations.

Several of Feige's results are of interest when considering the t-ratio. His failure to observe a substitution relationship between savings and loan shares and commercial bank time and savings deposits is surprising. Also surprising is the fact that he found a higher income elasticity for demand deposits than for savings and loan shares and for time deposits. Specifically, the income elasticity of demand for demand deposits was a little less than unity, while income elasticity was 0.63 for savings and loan shares and 0.69 for time deposits. These results are contrary to what was expected and found in studies of the t-ratio. However, in tests for stability of the demand functions across time, Feige found that the income elasticity of demand for time deposits was near unity over the period 1949-53 and 0.49 in the period 1954-58.

A third of Feige's results that is of interest is his finding of complementarity in the relations between savings and loan shares and

demand deposits and between mutual savings bank deposits and demand deposits. Feige explained this by observing that savings and loan associations and mutual savings banks hold demand balances at commercial banks which could be expected to rise as their own liabilities rose.²⁰ It could also be that the public has some preference for demand deposits relative to thrift accounts (the total of commercial bank time and savings accounts, mutual savings bank deposits, and savings and loan shares). As more of the thrift accounts are held in the form of savings and loan shares and mutual savings bank deposits, a greater share of bank reserves are used to support demand deposits than would otherwise be the case.

Another cross-section study, one by Jerry Jordan, produced results at odds with those of Feige.²¹ Jordan's demand functions for time deposits, mutual savings bank deposits and savings and loan shares include relative yields, an income variable, and a relative convenience-cost variable. Like Feige, he also includes per capita advertising expenditures in the savings and loan equation. Jordan's results with cross-section data by states for various subperiods between 1956 and 1966 show the income elasticity of demand for time deposits generally in the range of 1 to 2 and a considerably smaller income elasticity of demand for savings and loan shares. They also show demand for various assets to be responsive to changes in yields on other assets, suggesting a substitution relationship in demand.

²⁰Feige, The Demand for Liquid Assets, p. 26.

²¹Jordan, "The Market," pp. 152-69.

Other studies, including ones using aggregate time series data, also go into the issue of substitutability among financial assets. In a review of most of these studies, Gary G. Gilbert and Neil B. Murphy summarize the results of time series studies, in part, by saying that savings and loan shares appear to be the closest substitutes for commercial bank time and savings deposits and that substitution relationships among financial assets are unstable over time.²²

Analysis of bank behavior in establishing interest payments offered on various types of liabilities appears in a number of studies. These studies generally specify a utility or objective function which banks are presumed to have and then go on to specify how banks could be expected to behave in order to maximize the objective function, given certain conditions external to their control. One study focuses on bank price-setting behavior for demand and time deposits; several others concern bank behavior in the context of analysis of the supply of bank certificates of deposit.

In the study analyzing price-setting for demand and time deposits, Michael Klein and Neil Murphy view the rate on each type of deposit as an increasing function of the profitability of bank lending (the expected return on the bank's portfolio of earning assets), and a decreasing function of the public's demand for that type of deposit and market concentration.²³ Their empirical work is based on 1968 data for a sample

²²Gary G. Gilbert and Neil B. Murphy, "Competition Between Thrift Institutions and Commercial Banks: An Examination of the Evidence," Journal of Bank Research 2 (Summer 1971), p. 10.

²³Michael A. Klein and Neil B. Murphy, "The Pricing of Bank Deposits: A Theoretical and Empirical Analysis," Journal of Financial and

of 164 standard metropolitan statistical areas. In their results for rates on time deposits, the coefficient of the portfolio yield variable was of the expected sign and statistically significant.²⁴ In their results for demand deposits, however, the measure of portfolio yield had coefficients smaller than their standard errors and the sign varied among equations specified slightly differently.

Studies of the supply of bank certificates of deposit have also regarded loan demand as of importance in influencing bank offering rates. The paper by Jerry Jordan, cited earlier, contains a section on large negotiable CDs. Supply of large CDs is viewed as a function of the supply of earning assets to banks and of the marginal costs of alternative sources of funds. However, Jordan does not elaborate a model including those costs. He estimates supply functions including interest rates on bank assets, CD rates and outstanding business loans at large commercial banks, along with demand functions, using two stage least squares. Signs in the supply equations were not consistent with those predicted by theory in all cases. Jordan concludes that there were problems of identification, due possibly to the small number of observations.

An analysis conducted by Sandra Cohan includes small denomination

Quantitative Analysis 6 (March 1971):747-61.

²⁴This yield was measured as the total amount of net revenue from administering the earning asset portfolio divided by a monthly average of the earning asset portfolio with data from the Federal Reserve Functional Cost Analysis. For a description of other data used to measure empirically the variables in the theoretical model, see the table in *Ibid.*, pp. 755-56.

CDs as well as large negotiable CDs.²⁵ She too mentions that the supply of CDs is expected to respond to loan demand and to costs of alternative sources of funds. The main alternative source of funds is viewed as a reduction in the bank's liquidity position. Her empirical analysis, based on quarterly data III/1961-IV/1967, concludes that the main determinants of rates paid on large CDs are the Treasury bill rate and Regulation Q ceilings. The main determinants of rates paid on small denomination CDs include yields on savings accounts at competing financial institutions, the rate paid on large CDs and the rate on short-term bank loans. She concludes, moreover, that banks' response to changes in the Treasury bill rate takes place within a single quarter.

A study of large negotiable CDs by Joseph Rossman focuses on banks' use of them to enhance their profitability, liquidity and soundness.²⁶ His theoretical model explicitly takes account of how market factors, such as various yields, and other external conditions, such as reserve requirements, would be expected to affect each of these three qualities through balance sheet and income relations and how, in turn, banks might be expected to respond to changes in these conditions.

Summary of Factors Expected to Affect the t-Ratio

The t-ratio reflects the choice of the public among different types of financial assets and factors conditioning that choice. Let us consider this choice to be the demand side of determination of the t-ratio.

²⁵Sandra B. Cohan, "The Determinants of Supply and Demand For Certificates of Deposit," Journal of Money, Credit and Banking 5 (February 1973):100-12.

²⁶Rossman, "A Study," pp. 36-59.

Among factors conditioning the choice, some may be regarded as determinants of supply and others may be regarded as determinants of demand, as should become clear in the following discussion.

Economic theory suggests that the choice of what assets to hold is dominated by comparison of yields on the various alternatives. Some financial assets, as well as physical assets, provide a flow of non-pecuniary services. This flow of services must be considered part of the yield in addition to, or as an alternative to, an explicit pecuniary return. Money, which serves to minimize transactions costs, is such an asset. Specifically, theory suggests that asset holders allocate their wealth among various assets so that the yield -- pecuniary plus nonpecuniary -- on each asset is equated at the margin. By doing so the asset holder maximizes the return on his wealth. Because of differences in preference for nonpecuniary returns relative to pecuniary returns and differences in time preference among asset holders, not all individuals and firms will arrive at the same composition of assets in their portfolios. Nevertheless, in the aggregate, one can say that an increase in the pecuniary return on a given financial asset will increase the proportion of assets held in that form and decrease the proportion held in some other form, given that changes in other yields and relevant factors do not offset the effect.²⁷

²⁷With physical assets, as opposed to financial assets, changes in aggregate asset composition take place primarily through changes in price. In response to a change in yields, physical assets, initially at least, do not disappear; they change in value; additionally, they may change in form or use through production activities. Financial assets also change in price. They change form somewhat more easily than do physical assets. For example, it is much easier to transform time deposits into demand deposits than steel into cars or cars into scrap metal.

How a given change in pecuniary relative yields will affect the relation between commercial bank time deposits and demand deposits is conditioned by balance sheet relations and other factors which determine demand curve positions. In other words there are constraints on the totals. The influence of balance sheet relations can be illustrated by working through some hypothetical effects of a rise in the yield on deposits at nonbank financial institutions.

Consider partial financial balance sheets for three groups in a simplified financial sector of the economy: (1) commercial banks (CB), (2) nonbank financial institutions (NB), and (3) the public, consisting of households and nonfinancial firms (P) (see Exhibit 1). Assume there are fixed outstanding stocks of Government securities (GS) and commercial bank reserves (R) and that no changes take place in currency holdings of the three groups (so that currency can be ignored). Assume that the reserve requirement on time deposits (r_{TD}) is lower than on demand deposits (r_{DD}) and that commercial bank demand for excess reserves is zero so that reserves are the sum of required reserves on demand deposits (R_{DD}) and required reserves on time deposits (R_{TD}). These assumptions can be restated as follows, where TD stands for time deposits and DD for demand deposits.

$$(2.11) \quad GS = \overline{GS} = GS^{CB} + GS^{NB} + GS^P$$

$$(2.12) \quad R = \overline{R} = r_{TD}(TD) + r_{DD}(DD)$$

$$(2.13) \quad r_{TD} = \overline{r_{TD}} < r_{DD} = \overline{r_{DD}}$$

In addition, the following relations hold for banks and nonbank financial institutions.

 Commercial Banks

Assets	Liabilities
Reserves = $R_{DD} + R_{TD}$	Demand Deposits = DD^{NB}
Loans = L^{CB}	+ DD^P
Securities = GS_{CB}	Time Deposits = TD

 Nonbank Financial Institutions

Assets	Liabilities
Demand Deposits = DD^{NB}	Deposits = DNB
Securities = GS^{NB}	
Loans = L^{NB}	

 Public

Assets	Liabilities
Demand Deposits = DD^P	Loans = $L^{CB} + L^{NB}$
Time Deposits = TD	
Deposits = DNB	
Securities = GS^P	

Exhibit 1. Partial Balance Sheets in a Simplified Financial Sector

$$(2.14) \quad R + L^{CB} + GS^{CB} = DD^{NB} + DD^P + TD$$

$$(2.15) \quad DD^{NB} + GS^{NB} + L^{NB} = DNB$$

Assume initially there is equilibrium. Then assume something happens (in the real sector) to increase demand for loans from nonbank intermediaries. A perceived increase in returns on their assets induces these intermediaries to offer a higher rate of return on their liabilities to acquire additional deposits in order to make loans. The public, in turn, shifts asset holdings into these deposits (DNB). The question is whether the public draws down time deposits, demand deposits, or securities in order to acquire more of these other deposits. If the public reduces time deposit holdings, banks would experience a temporary balance sheet contraction. However, in order to maintain assumption (2.12) that reserves remain constant, assume that transfers of accounts occur instantaneously so that as soon as time deposits fall, demand deposits rise. This is not an unreasonable assumption since demand deposits are the medium through which the transactions involving the shifts in deposits take place, and later are held by the individual obtaining a loan from the nonbank intermediary and then used in his subsequent purchases. This chain of events leaves bank reserves unchanged, but the shift from time deposits to demand deposits makes the banking system reserve holdings deficient relative to requirements. The deficiency can be removed by a contraction of deposits and assets. For example, suppose $r_{TD} = .05$, $r_{DD} = .10$, $R = \$100$, $TD = \$1,000$ and $DD = \$500$. Then, if DNB increase by \$100 and TD decline by \$100, DD will temporarily rise by \$100 also. This, however, will produce a reserve deficiency of \$5. Bank loans and deposits must con-

tract to where $.10DD + .05TD = \$100$. The distribution of the deposit contraction will determine the effect on the t-ratio. If banks do not raise yields on time deposits, the t-ratio could be expected to fall.

If banks raise yields on time deposits, they may be able to induce people to hold time deposits in the same proportion to demand deposits as before the rise in rates on deposits at nonbank financial institutions. On the other hand if bank reserves increase, banks will be able to avoid contractions even though demand deposits are absorbing a larger portion of their reserves.

If the public substitutes deposits at nonbank intermediaries into their asset portfolios in place of securities rather than time deposits, loans at banks would tend to contract (still assuming a rise in loan demand at nonbank intermediaries) as banks shifted their asset portfolios toward securities and relations (2.11), (2.14) and (2.15) are maintained. There would be no necessary effect on the t-ratio.

If the public substitutes deposits at nonbank intermediaries for demand deposits, total credit in the system would rise; however, there would not necessarily be any change in the t-ratio, given a fixed amount of reserves and assuming that the transactions involving, and subsequent to, the rise in the flow of credit from nonbank intermediaries simply shifted the holding of the demand deposits among members of the public.

Factors other than relative pecuniary yields affect demands for time deposits and for demand deposits and also demands for them in relative terms. Changes in income and season, for example, may be thought of as altering the nonpecuniary yield associated with a particular type of financial asset. This is equivalent to viewing these things as

factors which shift the demand curve expressed as a function of relative pecuniary yields. Assume that the quantity of financial asset x relative to financial asset y demanded is a function of their relative pecuniary yields. This is expressed diagrammatically in Exhibit 2. The demand for x relative to y is negatively related to the relative yield $\frac{i^y}{i^x}$. If a change in income produces an increase in the nonpecuniary yield on x , then the demand curve will shift to the right, say from D_1 to D_2 . That is, for every $\frac{i^y}{i^x}$, people want more x relative to y .

Factors which cause a change in relative yields on financial assets can be regarded as the supply side of determination of the t -ratio. The supply factors which appear in the literature discussed in the previous section of this chapter are reserve requirements, strength of competition, and other factors affecting relative costs of different sources of funds to banks, loan demand, and Regulation Q.

A change in reserve requirements on time deposits relative to demand deposits is likely to affect the relative rates of return banks offer on them or change other costs they are willing to bear in order to supply each type of deposit, given other market factors are unchanged. Since required reserves are a nonearning asset, an increase in reserve requirements on time deposits, for example, would reduce the proportion of these deposits on which banks could earn a yield and hence, with unchanged asset yields, banks would bid less aggressively for these deposits.

The historical material presented by Cagan and Friedman and Schwartz and discussed earlier in this chapter, along with the theoretical discussions presented by Warren Smith and by James Tobin and William Brainard support the likelihood that differential reserve requirements affect the

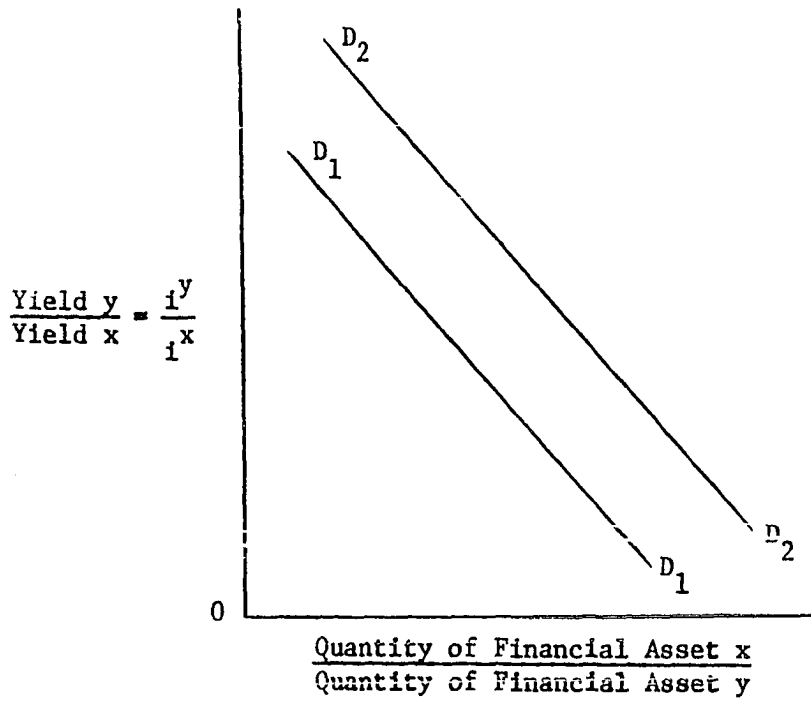


Exhibit 2. Relative Demand for Financial Assets as a Function of Relative Yields

composition of financial intermediary liabilities.²⁸ Reserve requirements also appear in statistical studies. For example, in his investigation of banks' use of large CDs, Joseph Rossman found reserve requirements on large CDs and on Eurodollars significant.²⁹ Richard Zecher, in examining four econometric models, investigated the impacts of changes in reserve requirements on time deposits and demand deposits. He explains that the effects of changes in reserve requirements in the models are produced by altering banks' excess demand for excess reserves and, in turn, bank asset holdings, which in turn affects interest rates and deposits. The behavior of banks in affecting relative yields through changing interest rates offered on time deposits and/or service charges on demand deposits is not mentioned, however. Rather, the supply response is presumed to be measured by the change in the Treasury bill rate.³⁰

A change in the cost of a source of funds other than time or demand deposits can also affect the supply price of bank time deposits relative to demand deposits. Other sources of funds include borrowing from Federal Reserve Banks, in the Federal funds market or in the Eurodollar market. Under the assumption that banks behave so as to maximize profits,

²⁸ See Warren L. Smith, "Time Deposits, Free Reserves, and Monetary Policy," in Issues in Banking and Monetary Analysis, ed. Giulio Pontecorvo, Robert P. Shay, and Albert G. Hart (New York: Holt, Rinehart and Winston, Inc., 1967), pp. 79-113; James Tobin and William C. Brainard, "Financial Intermediaries and the Effectiveness of Monetary Controls," in Essays in Economics, Vol. 1, Macroeconomics, ed. James Tobin (Chicago: Markham Publishing Company, 1971), pp. 283-321.

²⁹ Rossman, "A Study," p. 78.

³⁰ Joseph R. Zecher, "An Evaluation of Four Econometric Models of the Financial Sector" (Ph.D. dissertation, Ohio State University, 1969), p. 67.

at equilibrium, the marginal costs of different sources of funds are equal. A shift in the cost of one source of funds will cause adjustments to restore equality in marginal costs. Because of likely differences in economies of scale and different combinations of implicit and explicit costs among different sources of funds, the adjustments may establish a new relative supply price pattern. It seems reasonable to suggest that the elasticity of supply is greater for demand deposits than for time deposits, because the main cost of time deposits (explicit interest payments) is tied directly to volume, whereas costs of demand deposits depend on conditions which may involve economies of scale. That being the case, a reduction in the cost of funds obtained through borrowing in the Federal funds market might reduce banks' incentive to issue time deposits and consequently lower their supply price relative to that for demand deposits.

A change in demand for bank loans which amounts to a change in the rate of return on bank assets affects the t-ratio in a way similar to the way a change in relative costs of funds affects it. It seems reasonable to suggest that the demand for bank loans (supply of earning assets to banks) is positively related to the supply of deposits, as indeed was done by Jordan, Cohan and Rossman in their respective studies of the CD market. However, is there any reason to expect that it would affect the relative supply (rates offered) of demand deposits to time deposits? Supply elasticities again are important. In addition to the aspects of this mentioned in the previous paragraph, external supply constraints on one or the other type of deposits might exert a force. For example, since interest payments on demand deposits are prohibited

by law, in the presence of strong loan demand, banks compete more strongly for time deposits by offering higher yields on time deposits, up to the maximum permissible. Once those ceilings are reached, banks devise other ways to compete for deposits. It appears that strong loan demand prompts this competition. Means of competing might involve relaxation of service charges on demand deposits and offering additional services. Changes in interest rates on bank loans, given reserve conditions, might be viewed as a measure of loan demand. Expected future interest rates on bank assets as well as recent changes will affect banks' competitive response in altering yields on liabilities.³¹ Given uncertainties, yields on short-term liabilities (short-term CDs) would probably be adjusted more frequently than rates offered on other time deposits and implicit yields on demand deposits.

Strength of competition among banks, and between banks and other financial institutions, is also a supply factor influencing the t-ratio. If in a given market, for example, there is no aggressive bidding for deposit funds, the spread between yields on the two types of deposit and the relation of time deposits to demand deposits in that market would probably be lower than in a market where banks see an opportunity to gain more deposits and increase assets earnings through competing.

Of the supply factors affecting the t-ratio, Regulation Q is the one most frequently cited. It implicitly interacts with the forces of loan demand and competition by restraining banks' responses to them. When Regulation Q is effective, that is, when market rates on financial assets

³¹Jordan, "The Market," p. 143.

approach and rise above maximum interest rates payable on time deposits, Regulation Q exerts a negative impact on the t-ratio.

In addition to these factors and through them, the level and changes in bank reserves enters as a factor influencing the t-ratio. The amount of reserves constrains the size of the banking system and the total amount of bank deposits. The constraint it exercises on assets and liabilities of other parts of the financial sector is more remote. If nonbanking portions of the financial sector increase their role in intermediating credit transactions, while banks are constrained by reserves and reserve requirements, one would expect the t-ratio to rise.

The following factors, then, can be expected to affect the t-ratio.

Demand forces

1. Changes in relative pecuniary returns on different financial assets
2. Income
3. Season
4. Other factors which affect relative nonpecuniary or implicit yields on financial assets

Supply forces

1. Relative reserve requirements
2. Costs of alternative sources of funds
3. Loan demand
4. Strength of competition
5. Interest rate ceilings
6. Bank reserves

CHAPTER III.

THE MODEL

Approach

There are at least two ways to develop a model to explain the behavior of the t-ratio. One way is to specify a model for the financial sector based on assumptions about the behavior of participants and on constraints on their activities. Such a model would include demand and supply equations for time deposits and demand deposits and relations determining the explanatory variables in those equations. This would lead to a reduced form equation for demand deposits and time deposits. Then the ratio could be computed. A second approach is to focus directly on the t-ratio, hypothesizing what effects are expected from a set of theoretically related variables.

The second approach is essentially what was used in previous studies of the t-ratio cited in Chapter II. Because the scope of this paper is confined to the t-ratio, it is also the approach employed here. A model of the financial sector, on the other hand, would embody implications ranging wide of the t-ratio. While the model used does not specify all of the interrelations prevailing in the financial sector, it does pay attention to behavioral assumptions and constraints which have direct implications for the t-ratio. In particular, the simplified balance sheets shown in Exhibit 3 and the following relations determined from them must hold.

Federal Reserve System

Assets	Liabilities
Government Securities	Deposits of Member Banks Currency

Commercial Banks

Assets	Liabilities
Reserves Loans Government Securities	Demand Deposits Time Deposits Large Negotiable CDs Savings Deposits Other Time Deposits

Nonbank Financial Institutions

Assets	Liabilities
Demand Deposits Loans Government Securities	Deposits

Public

Assets	Liabilities
Currency Demand Deposits Time Deposits Deposits at Nonbank Financial Insti- tutions Government Securities	Loans

Exhibit 3. Balance Sheets

(3.1) Definition of the monetary base

$$B = GS^{\text{FRS}} = \text{RFRS} + C$$

(3.2) Distribution of Government debt

$$GS = GS^{\text{FRS}} + GS^{\text{CB}} + GS^{\text{NB}} + GS^{\text{P}}$$

(3.3) Distribution of bank reserves

$$R = \text{RFRS} + C^{\text{CB}} = r_{\text{DD}}(\text{DD}) + r_{\text{CD}}(\text{CD}) + r_{\text{SD}}(\text{SD}) + r_{\text{OTD}}(\text{OTD}) + E$$

(3.4) Commercial bank balance sheet identity

$$R + L^{\text{CB}} + GS^{\text{CB}} = \text{DD} + \text{CD} + \text{SD} + \text{OTD}$$

(3.5) Nonbank financial institution balance sheet identity

$$\text{DD}^{\text{NB}} + L^{\text{NB}} + GS^{\text{NB}} = \text{DNB}$$

(3.6) Net financial wealth of the public

$$\text{NFW} = GS^{\text{P}} + C^{\text{P}} + \text{DD}^{\text{P}} + \text{DNB} + \text{CD} + \text{SD} + \text{OTD} - L$$

Superscripts refer to the group holding the asset (FRS = Federal Reserve System, CB = commercial banks, NB = nonbank financial institutions, and P = public), and

B = monetary base

GS = Government securities

RFRS = bank reserves held as deposits at Federal Reserve Banks

C = currency

R = total bank reserves

DD = demand deposits

CD = large negotiable CDs

SD = savings deposits

OTD = other time deposits

r_{DD} = average reserve requirement on demand deposits

r_{SD} = average reserve requirement on savings deposits

r_{CD} = average reserve requirement on large CDs

E = excess reserves

L = loans

DNB = deposits at nonbank financial institutions

NFW = net financial wealth of the public

Identities similar to (3.2) which are obvious from the balance sheets could be specified for currency, demand deposits, and loans.

The model specified in the following pages differs from those employed in earlier studies of the t-ratio in several ways. A chief difference is that the time deposit portion of the ratio is decomposed permitting more precise specification and measurement of explanatory variables. The t-ratio is segmented into components because three categories of time deposits differ fundamentally from each other. The three categories -- savings deposits, large negotiable CDs, and other time deposits -- correspond to the s-ratio, the n-ratio and the a-ratio. The three categories differ primarily with regard to maturity and denomination. Differences in these two qualities alone could cause changes in banks' desired stocks to vary among the types of deposit for given changes in expected interest rates or reserve conditions. In addition, banks face constraints in the form of interest rate ceilings which vary among the types of deposits. Table 1 shows changes in Regulation Q interest rate ceilings since 1968. Maturity and denomination are also significant

Table 1

Maximum Interest Rates Payable on Time and Savings Deposits ^a

Type of Deposit	Ceiling Rate on Date Effective			
	April 19, 1968	January 21, 1970	June 24, 1970	May 16, 1973
Savings Deposits	4	4-1/2	4-1/2	4-1/2
Other Time Deposits: ^b				
Multiple maturity:				
30-89 days	4	4-1/2	4-1/2	4-1/2
90 days - 1 year	5	5	5	5
1-2 years	5	5-1/2	5-1/2	5-1/2
2 years or more	5	5-3/4	5-3/4	5-3/4
Single maturity:				
Less than \$100,000:				
30 days - 1 year	5	5	5	5
1-2 years	5	5-1/2	5-1/2	5-1/2
2 years or more	5	5-3/4	5-3/4	5-3/4
\$100,000 or more:				
30-59 days	5-1/2	6-1/4	- ^c	- ^c
60-89 days	5-3/4	6-1/2	- ^c	- ^c
90-179 days	6	6-3/4	6-3/4	- ^c
180 days - 1 year	6-1/4	7	7	- ^c
1 year or more	6-1/4	7-1/2	7-1/2	- ^c

Type of Deposit	Ceiling Rate on Date Effective			
	July 1, 1973	November 1, 1973	November 27, 1974	December 23, 1974
Savings Deposits	5	5	5	5
Other Time Deposits: ^b				
Less than \$100,000:				
30-89 days	5	5	5	5
90 days - 1 year	5-1/2	5-1/2	5-1/2	5-1/2
1 - 2-1/2 years	6	6	6	6
2-1/2 years or more	6-1/2	6-1/2	6-1/2	6-1/2
Minimum denomination of \$1,000				
4-6 years	- ^d	7-1/4	7-1/4	7-1/4
6 years or more	- ^d	7-1/4	7-1/4	7-1/2
Governmental units	- ^e	- ^e	7-1/2	7-3/4
100,000 or more	- ^c	- ^c	- ^c	- ^c

^aFederal Reserve Bulletin (April 1975).

^bIn this table, other time deposits refers to all time deposits other than savings deposits, including large CDs.

^cCeiling rate suspended.

^dNo ceiling on these deposits up to 5 percent of a bank's total time and savings deposits. Deposits in this category issued beyond that amount were subject to a 6-1/2 percent maximum rate.

^eThe highest rate payable on government unit accounts were the same as for private accounts according to maturity and denomination.

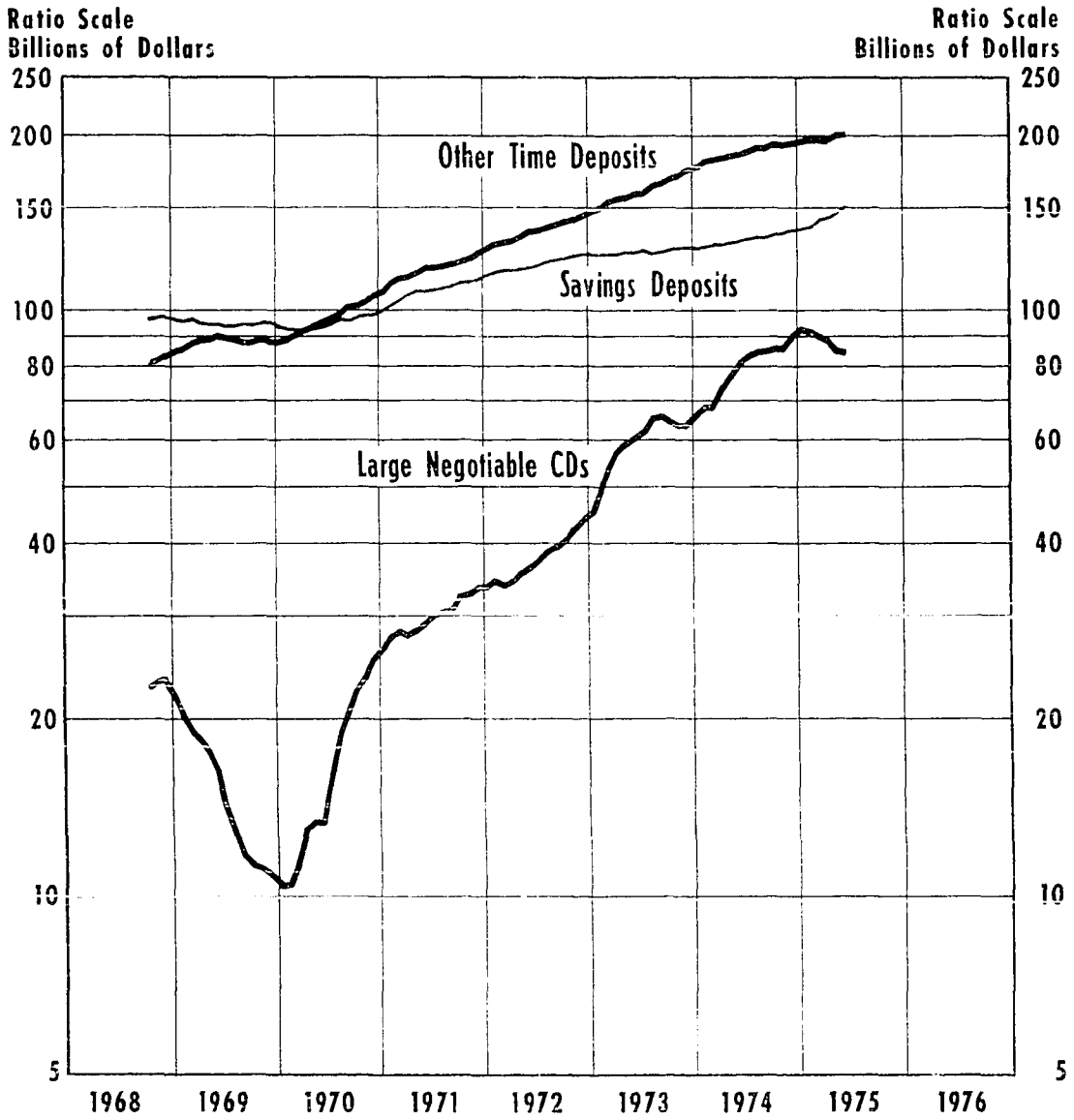
qualities to asset holders. Minimum denominations, especially one of \$100,000, effectively preclude purchase by individuals and businesses with small or moderately sized incomes and wealth. Specific maturities entail transactions costs and varying degrees of flexibility to the asset holder, while negotiability restores some flexibility and adds liquidity to the asset.

The significance of differences among the three types of time deposits appears to be confirmed by variations in their behavior (see Figure 5). All three components of time deposits have risen since 1968 and have contributed to increases in the t-ratio. However, rates of increase have differed among them. A possibility is that variation between the growth of savings deposits and growth of other time deposits is due at least partly to substitution between them. To the extent that this occurs, there is no net effect on the t-ratio as a whole. Because the component ratios added together equal the t-ratio, this possibility does not complicate the analysis.

The fact that total demand deposits, not just the portion held by holders of the segment of time deposits under consideration, appears in each ratio does complicate the analysis. Anything that affects demand deposits is likely to affect each component ratio. This will be taken into account in the equations by including some measure to capture the supply constraint on total bank deposits.

In line with the preceding discussion, the model is viewed as separable into three parts -- each part representing a component ratio. The specification of each part assumes that determinants of the other parts are given.

Figure 5. Time Accounts at Commercial Banks*



*Data are seasonally adjusted.

The model will be discussed in four sections, one for each component-ratio and a summary. The discussion includes a precise specification of independent variables for each equation, a theoretical explanation of the specification and expectations regarding the signs of coefficients. The summary section highlights the assumptions implicit in the specification and enumerates the propositions which estimates will be used to evaluate.

The s-Ratio

Savings deposits are distinct from both demand deposits and what are technically called time deposits -- certificates of deposit and time deposits - open account. Savings deposits differ from demand deposits in that they bear a specific nominal interest rate and are not transferable by check. Savings deposits differ from other time accounts in that they lack specific denomination and maturity. Rather, savings accounts can generally be added to or withdrawn from by presentation of the account passbook at the banking office.

From a bank's point of view, the fact that competition for savings deposits involves an explicit interest expense makes these deposits a less attractive source of funds than demand deposits. Partly offsetting this disadvantage, however, has been the lower reserve requirement on savings deposits. At banks that are members of the Federal Reserve System, the reserve requirement is 3 percent on savings deposits, while on demand deposits marginal reserve requirements range from 7-1/2 percent to 16-1/2 percent depending on the size of the bank.¹ In addition, the prospect of greater stability associated with time accounts makes it

¹Required reserve ratios are those in effect December 31, 1975.

possible to invest funds in longer-term assets which often have greater yields than business loans.² So long as asset yields are high enough to permit banks to earn a net return on funds obtained by offering interest, it is worthwhile for them to compete in doing so.

Among types of time accounts, savings deposits are a relatively attractive source of funds because they generally can be obtained at lower cost than deposits fixed in denomination or maturity. However, the ease of withdrawal of savings deposits makes potential competition from price changes on other assets -- such as savings and loan shares, or Treasury bills -- more of a threat than is the case with longer-maturity certificates. Given this potential for withdrawal of funds, along with the considerable importance of savings deposits among sources of funds, banks may be reluctant to lower yields on savings deposits when other interest rate conditions change temporarily.³

From the point of view of asset holders, savings deposits have an advantage over demand deposits because of the interest return and an advantage relative to many other interest-bearing assets because they are relatively liquid, convenient, and free of risk of losing the nominal principal amount. Traditionally, savings deposits have been a form in

²See Paul M. Horvitz, "Economies of Scale in Banking," Private Financial Institutions, Commission on Money and Credit (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1963), pp. 40-50.

³In early 1971 and again in early 1972, after yields on six-month large CDs had fallen drastically (about 1-1/2 percentage points) averages of most common rates paid on savings deposits and on consumer-type time deposits fell only a few basis points. From mid-1974 to mid-1975, when the rate on large six-month CDs fell almost 6 percentage points, average yields paid on other types of time deposits, taken as a group, continued to rise.

which individuals, small businesses and nonprofit organizations hold idle funds. From 1933 until recently, corporations operated for profit and governmental units were ineligible to hold savings deposits. This restriction was relaxed for governmental units in November 1974 and for corporations in November 1975. The change in Regulation Q permitting corporations to hold savings deposits specifies a \$150,000 limit on a corporate account.

Savings deposits, in being relatively liquid among interest-bearing assets, can be viewed as a relatively close substitute for demand deposits. Some recent innovations have made savings deposits even more like demand deposits. One of these is the ability to make transfers from a savings account to a demand deposit account by telephone. The Board of Governors of the Federal Reserve System authorized member banks to permit such transfers in April 1975, altering a policy in effect since 1936.⁴ Ability to use remote terminals to gain access to savings account funds also increases the liquidity of savings deposits.

Savings deposits can also be regarded as substitutable, to a degree, for other financial assets, in particular Treasury bills or other Government bonds. In other words, changes in relative yields are likely to induce shifts toward holding the higher-yielding asset. Other deposit-type assets, such as small denomination certificates of deposit at banks and certificates and regular accounts at savings and loan associations and mutual savings banks, and credit union shares, are probably even closer substitutes to savings deposits. In addition, savings deposits

⁴See Federal Reserve Bulletin 61 (April 1975):261.

may often be a temporary abode for funds to be used in purchasing equities or physical assets.⁵

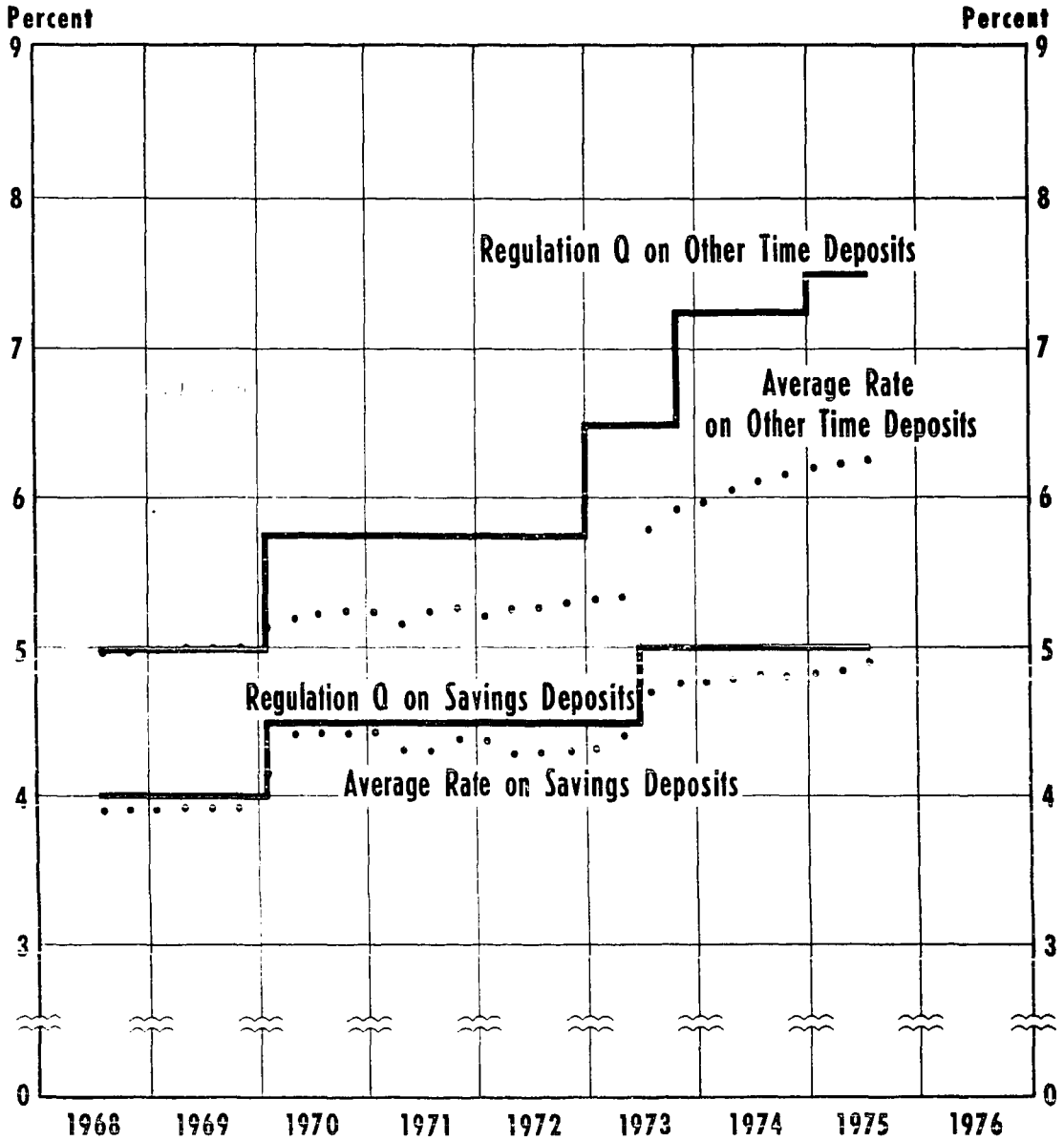
Savings deposits have risen only slightly in relation to demand deposits in recent years, and, on balance, they have declined relative to other types of time deposits. In late 1968 savings deposits comprised just under 50 percent of total time and savings deposits, whereas in 1975, they accounted for only 35 percent of the total. These comparisons are indicated in Figures 3 and 5.

Decreases in savings deposits relative to other time deposits have been accompanied by the proliferation of categories within the other time deposits grouping as indicated in Table 1, and by rising interest rates on other securities. The widening spread between Regulation Q ceilings on savings deposits and the highest rate payable on other time deposits is shown in Figure 6. While the spread between average rates paid on savings deposits and on other time deposits has increased only slightly since 1968, from 1 percentage point to about 1-1/4 percentage points, the spread between the Regulation Q ceiling on savings deposits and the highest ceiling for time deposits in the other time deposits group has increased from 1 percentage point to 2-1/2 percentage points.

While savings deposits generally have been regarded as less sensitive than other asset holdings to changes in yields, the yield on savings deposits relative to yields on other assets is probably a significant factor determining the growth pattern of savings deposits and the his-

⁵Eva Mueller and Jane Lean, "The Savings Account as a Source for Financing Large Expenditures," The Journal of Finance 22 (September 1967): 375-93.

Figure 6. Interest Rates on Savings Deposits and on Other Time Deposits



Source: Selected issues of the Federal Reserve Bulletin 54-61 (1968-1975).

Prepared by Federal Reserve Bank of St. Louis

torical relation between savings deposits and demand deposits. The financial asset that most closely resembles commercial bank savings deposits is the regular passbook account at savings and loan associations or mutual savings banks. Since 1966 interest rates offered by savings and loans have been subject to regulated maximum rates. Ceiling rates at savings and loan associations have remained higher than those at banks, but the margin has been reduced in recent changes, first from 3/4 of a percentage point to 1/2 of a percentage point in January 1970 and then to 1/4 of a percentage point in July 1973. This development could be expected to have had a positive effect on savings deposits at commercial banks, relative to savings accounts at savings and loan associations and might also be expected to have a positive effect on the s-ratio. However, to the extent that certificates at savings and loan associations presented a more attractive alternative to either type of passbook account, this variation in relative yields would have had little effect on savings deposits at commercial banks. Over the period since 1968, the breakdown of thrift-type deposits between commercial banks and non-bank thrift associations has been virtually unchanged. Of the total of nonbank thrift deposits and commercial bank time and savings deposits other than large negotiable CDs, about 54 percent are at nonbank thrift associations and about 46 percent are at banks.⁶ Over all months since 1968 the proportions have varied by less than 2 percentage points. This constancy suggests that changes in relative yields and institutional

⁶ Certificates of \$100,000 or more account for less than 2 percent of savings balances at savings and loan associations. See Richard C. Pickering, "Changes in S & L Savings Account Structure: April-September 1974," Federal Home Loan Bank Board Journal 8 (February 1975):24.

changes over this period have had little net effect on preferences for thrift deposits at banks relative to those at other thrift institutions.⁷

Explanation of the ratio of savings deposits to demand deposits requires consideration of demand deposits as well as savings deposits. The demand deposit portion of the s-ratio is influenced from the supply side chiefly by growth of bank reserves and by banks' demand for excess reserves. Changes in Government deposits, which absorb reserves, also exert a constraining effect on private deposits -- demand and time, but this generally would be a very short-run effect. On the demand side, demand deposits are influenced by substitutions between time and savings deposits and other financial assets as well as by substitutions between savings deposits and demand deposits.

Shifts from time deposits into other financial assets, such as Treasury bills, release bank reserves which may be used to increase demand deposits. Such shifts would occur primarily because of changes in relative yields. Increases in interest rates have a negative effect on the s-ratio to the extent that funds are shifted either from savings deposits to other time deposits or from other time deposits into nonbank financial assets. In the first instance savings deposit growth tends to slow. In the second instance, slowing of total time deposit growth

⁷ It might be noted that whatever competitive edge savings and loan associations lost with the narrowing between ceiling rates might have been offset by more aggressive nonprice competition by savings and loans in the form of advertising, premiums, and services to savers. The studies by Feige and Jordan found per capita advertising a significant determinant of savings and loan shares. See pp. 31-32 in Chapter II above. See also, Jean M. Lovati, "The Changing Competition Between Commercial Banks and Thrift Institutions for Deposits," Federal Reserve Bank of St. Louis Review 57 (July 1975):2-8.

releases reserves which may increase the growth of demand deposits, the denominator of the ratio.

Changes in explicit or implicit yields on demand deposits could also influence the public's desired holdings of savings deposits relative to demand deposits. No interest payments currently are allowed on demand deposits, but demand deposits yield services to holders and users of them. As with any asset, holding demand deposits involves an opportunity cost which is the yield foregone by not holding some other asset instead. In addition, demand deposits may involve an explicit cost or negative yield in the form of a service charge. One would expect asset holdings to shift away from demand deposits if yields on other assets increase or if service charges rise.⁸

Anticipated inflation could be expected to reduce the demand for demand deposits and for assets with fixed prices, in general, relative to assets whose prices are expected to rise.⁹ If yields on savings deposits were adjusted to incorporate changes in expected inflation, some of the shifts away from demand deposits could be expected to raise savings deposits and the s-ratio. To the extent, however, that declines in demand for demand deposits are reflected in increased demands for

⁸There are, of course, other factors that influence the demand for money, and the demand for it in the form of demand deposits relative to currency. Wealth and attitudes toward the soundness of the banking system are two such factors. Few of the many facets of the demand for money have direct implications for the t-ratio and the discussion in this paper excludes those facets which are regarded as only tangential to the determination of the t-ratio.

⁹Under certain institutional arrangements, inflation acts as a tax on money holdings. See Charlotte E. Ruebling, "Financing Government Through Monetary Expansion and Inflation," Federal Reserve Bank of St. Louis Review 57 (February 1975):15-23.

other assets and output, however, the s-ratio would be affected only indirectly, if at all. In addition, as long as interest rates on savings deposits cannot be adjusted fully to changes in expected inflation, inflation could be expected to have little effect on the s-ratio. However, if inflation affects asset holdings via a threshold effect, that is, changes in asset holdings take place once inflation increases to a certain pace, then accelerating inflation could produce a positive effect on the s-ratio, as well as the total t-ratio. This effect will be examined by including a measure of inflation in the equations.

Service charges on demand deposits cannot be treated like a negative interest payment because the charges are not always directly related to the size of the deposit. Rather, service charges are often related to the activity of an account or imposed when an account falls below some minimum level. Banks may reduce charges to induce more accounts, but sometimes reduced charges may cause people to hold smaller demand deposit balances. This might be the case with elimination of service charges for failure to maintain some minimum balance. Some studies have attempted to measure a "negative interest rate" on demand deposits by relating service charge income to the level of demand deposits. In the aggregate service charge revenue at insured commercial banks has had a very stable relation to demand deposits in recent years. It was 0.49 percent of demand deposits in 1966 and 0.47 percent in 1974 and varied between 0.45 percent and 0.51 percent in the intervening years.¹⁰ Consequently, while service charges on demand deposits could be expected to affect the

¹⁰ Annual Report of the Federal Deposit Insurance Corporation (Washington, D.C.: Federal Deposit Insurance Corporation, 1974), p. 230.

distribution of asset holdings between demand deposits and savings deposits, the impact of any changes in demand deposit service charges cannot be measured reliably.¹¹

What then could account for the rise in savings deposits relative to demand deposits since 1968? One factor is the rise in explicit interest payments on savings relative to net yields on demand deposits. This appears to have been the result of several developments. First, interest rates on bank assets rose making it profitable for banks to offer higher yields to compete for funds. Secondly, regulated interest rate ceilings on savings deposits were raised, though only slightly relative to other market rates, permitting banks to offer higher interest rates. Third, innovations in the payments mechanism and other developments increased implicit yields on savings deposits, that is, they increased services yielded by savings deposits relative to those yielded by demand deposits. A second factor which could account for rises in savings deposits relative to demand deposits is increased income. Other analysts have offered the hypothesis and some evidence that the income elasticity of demand for savings deposits is greater than that for demand deposits. Finally, inflation may have had a larger negative impact on desired demand deposit holdings than on other monetary assets.

On the basis of the factors discussed above, I would expect the s-ratio to be determined by changes in income, in bank reserves, and in

¹¹Another approach to measuring the yield on demand deposits, however, involves computing the marginal costs of producing monetary services and then assuming that perfect competition forces banks to pass along in some manner all marginal profits to depositors. See Benjamin Klein, "Competitive Interest Payments on Bank Deposits and the Long-Run Demand for Money," The American Economic Review 64 (December 1974):935.

relative yields. Relative yields are measured as the spread between the yield on three-month Treasury bills and the Regulation Q ceiling on savings deposits. The rate of inflation is expected to capture an implicit negative yield on holding demand deposits as prices rise. The yield on Treasury bills represents the yield on an alternative financial asset similar to savings deposits. Actually, other time deposits and savings and loan shares bear a closer similarity to savings deposits than do Treasury bills. However, spreads between ceiling rates on these assets do not have enough short-run movement over the estimation period to be an adequate measure of changes in relative yields on the monthly behavior of the s-ratio. Changes in bank reserves are measured as the deviation from trend of the growth of bank reserves, which in turn are measured as the monetary base less currency in the hands of the public. For the period October 1968 to June 1975 this hypothesis is given explicit form in the following relation:

$$(3.7) \quad s_t = \beta_{10} + \beta_{11} \left(\frac{Y}{CPI} \right)_t + \beta_{12} \dot{CPI}_t + \beta_{13} D_2 \dot{CPI}_t + \beta_{14} R_{dev}_t \\ + \beta_{15} (i_{b_t} - Q_{SD_t}) + \beta_{16} D_1 + \epsilon_t$$

where

s_t = the ratio of seasonally adjusted savings deposits at commercial banks to seasonally adjusted demand deposits

$\left(\frac{Y}{CPI} \right)_t$ = real personal income

\dot{CPI}_t = the annual rate of change of the consumer price index in the six months ending in t

D_2 = dummy variable equal to 1 for December 1973 through November 1974 to signify a period when inflation was greater than could have been anticipated

- R_{dev_t} = the deviation from trend of the growth of bank reserves
 i_{b_t} = the market yield on three-month Treasury bills converted from a discount basis to a true yield¹²
 Q_{SD_t} = the Regulation Q ceiling on savings deposits
 D_1 = a dummy variable for the regulatory change permitting governmental units to hold savings deposits in November 1974.

The expected signs of β_{11} , β_{12} and β_{16} are positive, while the expected signs of β_{13} , β_{14} , and β_{15} are negative. Conditions necessary for this relation to be observed are expected to have been present over the period from late 1968 through mid-1975. Results of empirical estimation of (3.7) for this period are examined in Chapter IV. Examination includes attempts to adjust to improve reliability of statistics. Observation of low explanatory power and/or signs other than those expected, follow-

¹²Interest rates on Treasury bills, commercial paper and bankers' acceptances are usually quoted on a "discount basis," whereas as yields on large CDs and most other securities are quoted on a "yield basis." The interest rate on a discount basis is the percentage relationship between income earned and the face value of a security while the interest rate on a yield basis is the percentage relationship between income earned and the price paid for a security. The latter is often called a "true yield."

In order to compare yields on Treasury bills and yields on bank time and savings deposits on an equivalent basis, interest rates on Treasury bills are converted to "true yields" by means of the formula:

$$R = \frac{dr}{1 - (dr \cdot \frac{t}{T})}$$

where R = true yield
 dr = yield on a discount basis
 t = maturity measured in days
 T = 360 days.

See Heebner, Negotiable Certificates, pp. 110-15; and U.S. Treasury Department, General Regulations With Respect to United States Securities, Department Circular No. 300, 3rd rev. (1964), pp. 21-23.

ing these procedures, can be construed as evidence that some factor or factors other than changes in relative yields, income and bank reserves, has been a significant force affecting the s-ratio or that the specified equation does not adequately capture the theory being tested.

The a-Ratio

The classification, other time deposits, used in this study includes all time deposits other than those reported as savings deposits or as large negotiable CDs at weekly reporting large commercial banks. This grouping includes a wide range of maturities and denominations. It includes Christmas club and other special accounts and various denominations of CDs ranging in maturities from 30 days to six years or more. Some of the CDs are negotiable. The number of categories subject to different interest rate ceilings has increased since the late 1960s as shown in Table 1. The changes in interest rate ceilings on these deposits have been in the direction of permitting higher interest payments on longer maturities.

Generally, time certificates have carried a higher interest rate than savings accounts. From a bank's point of view certificates of deposit and the other time accounts in the "other" grouping are desirable relative to demand and savings accounts because they represent funds that the bank generally can count on having at its disposal for a more predictable period. Because of this feature banks usually are willing to pay a somewhat higher rate for certificate accounts than for passbook accounts.¹³ At the same time asset holders generally demand a premium

¹³This relation would tend to reverse in a period of temporary

for holding less liquid financial assets. Those who purchase CDs do not necessarily lock up the principal amount for the entire term to maturity, but access to the funds prior to maturity engenders a greater cost than with savings deposits, in that there is an interest penalty for early withdrawal of CD funds.

In spite of these special features of the "other time deposits" group, the framework of analysis for the a-ratio is essentially the same as for the s-ratio. Changes in relative yields, income, and in the growth of reserves can be expected to dominate its behavior. As with the s-ratio, interest rate ceilings are a dominant factor in the behavior of relative yields.

Other time deposits surpassed savings deposits in amount in early 1970 following the change in Regulation Q ceilings which permitted interest rates on small CDs to rise 1-1/4 percentage points above the ceiling on savings deposits. By mid-1975 the amount of other time deposits was about 35 percent greater than the amount of savings deposits. In relation to total time deposits, other time deposits accounted for about 41 percent in late 1968. The proportion jumped to 45 percent by June 1969. It then continued to move upward slightly and since early 1970 has generally ranged between 45.5 and 46.5 percent.

As higher interest rates were permitted and offered on longer maturities, asset holders moved to take advantage of the higher yields.

slack in loan demand. In such a circumstance, banks would not necessarily want to attract more funds, but also might not want to lose funds. To accommodate this combination of objectives, they would lower rates payable on new certificate accounts, but maintain the interest rate on savings deposits to inhibit a runoff in savings deposits.

The amount of small CDs maturing in less than one year declined by \$10 billion between April 1973 and April 1975, while amounts in categories with longer maturities and higher interest rates rose. The amount in the one- to two-and-one-half years maturity range also declined following a sharp rise between April and July 1973 (see Table 2).

There has apparently been substitution among different maturities of CDs and there has possibly been some substitution between these CDs and other assets. Shifts to and from assets which are not included in time or savings deposits will affect the t-ratio. Certificates of deposit at savings and loan associations and Treasury bills and notes are probably the assets that are most like these CDs in terms of risk, denomination, maturity, and yield. Since the mid-1960s yields on small denomination certificates both at banks and at savings and loan associations have been essentially the maximum rates permitted by regulations. Over this period the spread between ceiling rates on similar instruments at banks and at savings and loan associations has been about unchanged with savings and loan associations permitted to pay 1/4 of one percentage point more than banks on most maturities. However, since late 1973 the spread has widened to 1/2 of one percentage point for maturities in the two- to four-year range. Since ceiling rates on savings and loan and bank CDs have moved essentially parallel to one another, shifts among them probably have not been a major factor affecting the t-ratio or any of the component ratios.

Yields on Government securities, however, are not subject to ceiling rates, but fluctuate in response to market forces. Consequently, spreads between yields on Government securities and certificates of de-

Table 2

Small Denomination CDs Outstanding ^a
(Billions of Dollars)

Date	Maturity		
	Less than 1 Year	1-2 Years	More than 2 Years
April 30, 1970			
Amount ^b	\$42.9	\$14.1	\$ 9.4
Rate	5%	5.5%	5.75%
July 31, 1970			
Amount	\$40.6	\$15.1	\$13.2
Rate	5%	5.5%	5.75%
October 31, 1970			
Amount	\$39.7	\$15.5	\$14.6
Rate	5%	5.5%	5.75%
January 31, 1971			
Amount	\$40.2	\$18.2	\$18.0
Rate	5%	5.5%	5.75%
April 30, 1971			
Amount	\$42.8	\$18.6	\$18.6
Rate	5%	5.5%	5.75%
July 31, 1971			
Amount	\$43.6	\$18.9	\$20.3
Rate	5%	5.5%	5.75%
October 31, 1971			
Amount	\$43.9	\$19.0	\$21.8
Rate	5%	5.5%	5.75%

^a"Changes in Time and Savings Deposits," surveys published periodically in the Federal Reserve Bulletin.

^bAmounts refer to the accounts of individuals, partnerships and corporations at insured commercial banks. Rates are the most common rate paid on each type of account.

Table 2 -- Continued

Date	Maturity			
	Less than 1 Year	1-2 Years	More than 2 Years	
January 31, 1972				
Amount	\$45.3	\$19.7	\$23.6	
Rate	5%	5.5%	5.75%	
April 30, 1972				
Amount	\$45.4	\$20.5	\$24.6	
Rate	5%	5.5%	5.75%	
July 31, 1972				
Amount	\$46.3	\$21.5	\$26.4	
Rate	5%	5.5%	5.75%	
October 31, 1972				
Amount	\$46.1	\$22.1	\$28.4	
Rate	5%	5.5%	5.75%	
January 31, 1973				
Amount	\$46.7	\$22.8	\$30.8	
Rate	5%	5.5%	5.75%	
April 30, 1973				
Amount	\$46.6	\$23.5	\$33.9	
Rate	5%	5.5%	5.75%	
Date	Maturity			
	Less than 1 Year	1 - 2-1/2 Years	2-1/2 - 4 Years	More than 4 Years
July 31, 1973				
Amount	\$43.3	\$48.2	\$ 9.3	\$ 3.2
Rate	5.5%	6%	6.5%	7%
October 31, 1973				
Amount	\$39.2	\$45.7	\$10.9	\$ 8.9
Rate	5.5%	6%	6.5%	7%

Table 2 -- Continued

Date	Maturity				
	Less than 1 Year	1 - 2-1/2 Years	2-1/2 - 4 Years	More than 4 Years	
January 31, 1974					
Amount	\$38.6	\$45.0	\$12.9	\$12.8	
Rate	5.5%	6%	6.5%	7.25%	
April 30, 1974					
Amount	\$37.6	\$42.7	\$14.4	\$17.1	
Rate	5.5%	6%	6.5%	7.25%	
July 31, 1974					
Amount	\$36.1	\$41.0	\$15.3	\$21.0	
Rate	5.5%	6%	6.5%	7.25%	
October 31, 1974					
Amount	\$34.6	\$38.7	\$15.9	\$24.6	
Rate	5.5%	6%	6.5%	7.25%	
Date	Maturity				
	Less than 1 Year	1 - 2-1/2 Years	2-1/2 - 4 Years	4-6 Years	More than 6 Years
January 31, 1975					
Amount	\$34.6	\$37.2	\$17.4	\$27.0	\$1.7
Rate	5.5%	6%	6.5%	7.25%	7.5%
April 30, 1975					
Amount	\$36.3	\$36.2	\$18.6	\$30.0	\$2.4
Rate	5.5%	6%	6.5%	7.25%	7.5%
July 31, 1975					
Amount	\$37.4	\$35.9	\$19.5	\$32.7	\$3.3
Rate	5.5%	6%	6.5%	7.25%	7.5%

posit could be expected to vary and to generate shifts in preferred and actual combinations of asset holdings. Both CDs and Government securities include a wide range of maturities. Yields on different maturities are likely to follow the same general upward or downward movement, but spreads between yields on different maturities do not remain constant over time. Recognizing this, nevertheless it will be assumed that yields on three-month Treasury bills capture the alternative opportunity presented by Government securities.

Direct substitution between demand deposits and other time deposits is subject to about the same considerations as the substitution between demand deposits and savings deposits (see pp. 62-64 above). Explicit yields on other time deposits have increased, while those on demand deposits (service charges) have remained about the same, and implicit yields on demand deposits may have declined at least in relative terms. The factors that have increased the liquidity of savings deposits have not been applicable to other time deposits, but to the extent that more rapid growth of savings deposits has absorbed reserves and reduced demand deposit growth, the denominator of the a-ratio is affected.

The same theoretical variables that were expected to determine the s-ratio are expected to determine the a-ratio, namely, income, bank reserves, and relative yields. This hypothesis is examined through the following relation:

$$(3.8) \quad a_t = \beta_{20} + \beta_{21} \left(\frac{Y}{CPI} \right)_t + \beta_{22} \dot{CPI}_t + \beta_{23} \dot{D}_2 CPI_t + \beta_{24} R_{dev}_t \\ + \beta_{25} (i_b - Q_{OTD}) + \epsilon_t$$

where Q_{OTD_t} stands for the highest Regulation Q ceiling on other time deposits and other variables are the same as described earlier. The expected signs of β_{21} and β_{22} are positive while the expected signs of β_{23} , β_{24} , and β_{25} are negative.

The n-Ratio

Large negotiable CDs have become an important source of bank funds and a quantitatively significant short-term liquid asset only since 1961. The outstanding volume of large CDs rose from essentially zero in 1961 to as high as \$92.7 billion in January 1975. Since late 1968 the volume has nearly quadrupled, on balance, rising from about \$23 billion in October 1968 to \$84 billion in June 1975.

Large negotiable CDs are distinct from other time and savings deposits both as a bank source of funds and as an asset. The size of these CDs, at least \$100,000, and frequently larger, generally restricts the type of banks issuing them to large and highly rated banks located in financial centers. Banks are classified according to the marketability of their CDs as prime, lesser-prime, or off-prime. Most large CDs are issued by the relatively few banks in the prime classification.¹⁴ Because of the size of large CDs, banks that issue them tend to pay more attention to individual transactions involving these CDs than they do with smaller accounts. In addition, banks make more frequent adjustments in interest rates on large CDs than in rates on smaller time accounts. In conjunction with this and because large CDs account for a relatively small portion of a bank's total liabilities, large CDs can be used to

¹⁴See Rossman, "A Study," p. 5.

equilibrate costs and yields at the margin with greater precision than some other sources of funds. For example, changes in a bank's reserve position or a fluctuation in yields on bank assets would tend to induce change in the rate offered on large CDs more readily than in the rate offered on savings accounts. To the extent that they provide a means for making such short-term adjustments, large CDs are similar to borrowings from Federal Reserve Banks, Eurodollar borrowings, and Federal funds, which are also used to make short-run adjustments.

As an asset, large CDs generally would find a place only in very large portfolios -- mainly those of corporations and governmental bodies. Within such portfolios large CDs would probably be viewed as similar to prime commercial paper and Treasury bills. Because they are negotiable, large CDs have a high degree of liquidity along with these other instruments. However, because large CDs are not insured by the Federal Deposit Insurance Corporation for the full amount, but currently only up to \$40,000, they would generally be expected to bear a higher yield than Treasury bills which are regarded as free of principal-loss risk. This premium need not prevail, however, when offering rates on new CDs are restricted from rising due to regulation, as has been the case in some past periods. Since late 1970 Regulation Q ceilings have not been a major constraint on the issuance of large CDs. In June 1970 ceilings on large CDs maturing in 30 days up to 89 days were suspended. Then in May 1973 ceilings on other maturities were also suspended. Moreover, in the intervening period, late 1970 through early 1973, market rates on comparable instruments were below the ceilings that had not been suspended, and therefore ceilings were not a supply constraint.

The explanation of behavior of the ratio of large CDs to demand deposits, the n-ratio, under consideration in this paper is a variation of those for the s-ratio and the a-ratio. The analysis involves evaluating the proposition that changes in the ratio can be explained by changes in income, the growth of bank reserves and relative yields.

The concept of income, however, differs from that used in equations for the s-ratio and the a-ratio. Little, if any, theoretical justification could be made for including real personal income, as in equations (3.7) and (3.8). The relevant variable would appear to be some measure of funds available for investment in short-term liquid assets. Since most CDs are held by corporations, corporation cash flow, consisting of after-tax net income plus depletion and depreciation allowances, would appear to be the empirical measure most closely related to this variable. However, this data is available only quarterly. Accordingly, business sales which is a monthly series will be used to measure the effect of "income" on the n-ratio.¹⁵

¹⁵In his examination of the demand for large negotiable CDs, Jerry Jordan considers three alternative measures to serve as an income or wealth variable. One is corporate profits before taxes and dividends. Two others are derived from the Federal Reserve's Flow of Funds accounts and consist essentially of net acquisitions of financial assets by the farm sector, corporate and noncorporate businesses, state and local governments and foreigners. See Jordan, "The Market," pp. 138-39.

Cohan estimated an equation for the demand for CDs (large and consumer-type lumped together) as a proportion of total liquid assets and included a wealth variable and a transitory income variable. The wealth variable was derived from the formula:

$$W = .139 \sum_{i=1}^{11} (0.9)^i \cdot \text{GNP}_{-i}$$

and transitory income was $\Delta Y - k$ where Y equals current GNP and k is the average quarterly growth in GNP over the estimation period. See Cohan,

Initially the equation for the n-ratio is specified as follows:

$$(3.9) \quad n = \beta_{30} + \beta_{31} \left(\frac{X}{CPI} \right)_t + \beta_{32} \dot{CPI}_t + \beta_{33} D_2 \dot{CPI}_t + \beta_{34} R_{dev}_t \\ + \beta_{35} (i_{b_t} - i_{CD_t}) + \epsilon_t$$

where $\left(\frac{X}{CPI} \right)_t$ is business sales deflated by the consumer price index and i_{CD_t} is the interest rate on three-month CDs, measured as the secondary market yield on these CDs published by Salomon Brothers and Hutzler or the Regulation Q ceiling, whichever is lower. This measure is assumed to be a good proxy for the new-issue rate on large three-month CDs. The signs of β_{31} and β_{32} are expected to be positive while signs of β_{33} , β_{34} , and β_{35} are expected to be negative.

Summary

Estimation of equations (3.7), (3.8) and (3.9) will provide an attempt to explain the behavior of the t-ratio by explaining changes in the three additive components of the t-ratio. Predetermined variables in those equations comprise empirical measures of a set of the factors discussed in Chapter II as those expected on theoretical grounds to affect the t-ratio. The equations reflect the hypothesis that the t-ratio and its components can be explained by changes in factors that

"The Determinants," pp. 107-08.

The variables used by Jordan and by Cohan are not appropriate for estimation with monthly data. It was judged that adjustments required to produce comparable monthly series would not result in a better proxy than business sales. For example, frequent revisions in monthly data on financial assets according to the sector holding them, because the revisions were not carried back more than one year, make the data inconsistent over the estimation period.

induce changes in the public's preferred combination of financial assets and by changes in monetary policy variables, which in the short-run have transitory effects on the stock of demand deposits. In other words, the public's preference for a certain composition of financial assets adjusts to a change in the growth of the potential stock of financial assets, that occurs when the growth of bank reserves increases or decreases, after the change in reserves has been manifest in a larger or smaller stock of demand deposits.

The main factors that are considered to induce changes in the public's preferred combination of financial assets are changes in relative pecuniary yields, income, season, and other factors that affect relative nonpecuniary yields. Relative pecuniary yield variables include spreads between the yield on a category of time deposits and the yield on an alternative interest bearing financial asset. In addition, the rate of change in the price level is presumed to be negatively correlated with the yield on demand deposits and hence some reflection of the yield on demand deposits relative to time deposits. Other factors that affect an asset holder's preferred combination of assets could be viewed as factors affecting relative nonpecuniary yields. These factors include income, season, and characteristics of the financial instruments other than the pecuniary return. Income is included in each equation. It is specified as real personal income in equations for the s-ratio and the a-ratio and as business sales in the n-ratio. Season is not introduced explicitly as a predetermined variable, but dependent variables are seasonally adjusted. There is no attempt to measure other nonpecuniary yields. An assumption or initial condition is that nonpecuniary yields remained

constant over the estimation period or else varied in a nonsystematic way so that they would not affect the estimation of parameters.¹⁶

Underlying some of the factors that induce changes in the public's preferred combination of financial assets are factors influencing bank behavior in setting yields on time and savings deposits. These factors include relative reserve requirements, competition for deposit funds, costs of alternative sources of funds, and constraints, such as interest rate ceilings. It is assumed that these factors are captured by the interest rate paid on each category of time deposits and there is no attempt to use empirical methods to explain those rates.

An explanation of the t-ratio is here taken to consist partly of an evaluation of certain propositions about the behavior of the t-ratio and its components. These propositions are the following.

1. A rise in the growth of bank reserves produces an increase in the expansion of demand deposits in the short run and thereby has a negative effect on each component of the t-ratio.
2. A rise (decline) in the yield on a given category of time deposits relative to other financial assets has a positive (negative) effect on the comparable component of the t-ratio.
3. Changes in income, relative yields, and in the growth of reserves explain most of the changes in the t-ratio which occurred from October 1968 through June 1975.

¹⁶Changes in nonpecuniary yields would result from changes in the quality or liquidity of an instrument or a special inducement to hold the asset, such as a special loan consideration or other service from a bank. Increases in the liquidity of savings deposits can be inferred from several developments in recent years, such as the authorization permitting banks to allow telephone transfers from savings accounts. However, there is no particular basis for determining how soon authorization gave way to the practice and thus became instrumental in the demand for savings deposits. These things should be considered in interpreting results.

The first two propositions will be evaluated by means of the sign and significance of coefficients of the selected empirical measures of theoretical variables in the estimated equations. The third proposition will be evaluated by examining the proportions of variation in the t-ratio components explained by the regression equations, that is, the \bar{R}^2 s.

CHAPTER IV.

ESTIMATION RESULTS AND CONCLUSIONS

Equations (3.7), (3.8) and (3.9) were estimated using the Ordinary Least Squares (OLS) procedure and monthly data over the period October 1968 through June 1975. In addition, the t-ratio was estimated with a regression equation containing variables in the equations for the components. Data for both dependent and predetermined variables, except for interest rates, were seasonally adjusted and incorporate revisions announced in January 1976.

The resulting estimations are shown below. The numbers in parentheses are t-values. A coefficient with a t-value greater than 1.96 in absolute value is regarded as statistically significant with a 95 percent level of confidence as the degrees of freedom approach infinity. In the estimations reported in this chapter, the degrees of freedom generally range from 70 to 76 which makes the critical value of the t-statistic about 2.00 for a 95 percent confidence interval. The multiple correlation coefficient adjusted for degrees of freedom (\bar{R}^2), the standard error (S.E.) and the Durbin-Watson statistic (D.W.) are listed below each estimation. See Appendix C for definitions of symbols for variables and sources of data.

$$(4.1) \quad s = .373072 + .000343 \left(\frac{Y}{CPI} \right) - .002210 \overset{\cdot}{CPI} + .000650 D_2 \overset{\cdot}{CPI}$$

(17.763) (11.104) (-1.963) (1.381)

$$+ .424511 R_{\text{dev}} - .469217(i_b - Q_{\text{SD}}) + .047836 D_1$$

(8.762) (-3.470) (9.464)

$$\bar{R}^2 = .880$$

S.E. = .0093
D.W. = .723

$$(4.2) \quad a = -.655402 + .001648\left(\frac{Y}{\text{CPI}}\right) + .023913 \dot{\text{CPI}} - .001756 D_2 \dot{\text{CPI}}$$

(-11.346) (19.366) (12.361) (-1.600)

$$- .114175 R_{\text{dev}} - 3.576892(i_b - Q_{\text{OTD}})$$

(-0.859) (-14.449)

$$\bar{R}^2 = .961$$

S.E. = .025
D.W. = .625

$$(4.3) \quad n = -.714991 + .008465\left(\frac{X}{\text{CPI}}\right) + .013311 \dot{\text{CPI}} - .007323 D_2 \dot{\text{CPI}}$$

(-6.115) (6.590) (3.816) (-3.196)

$$- .282402 R_{\text{dev}} - 3.332209(i_b - i_{\text{CD}})$$

(-1.003) (-4.994)

$$\bar{R}^2 = .806$$

S.E. = .050
D.W. = .192

$$(4.4) \quad t = -.903325 + .001255\left(\frac{Y}{\text{CPI}}\right) + .013601\left(\frac{X}{\text{CPI}}\right) + .020211 \dot{\text{CPI}}$$

(-9.289) (2.777) (4.182) (4.149)

$$- .002889 D_2 \dot{\text{CPI}} + .101625 R_{\text{dev}} - 4.941872(i_b - Q_{\text{OTD}})$$

(-1.278) (0.331) (-7.828)

$$- 2.764559(i_b - i_{\text{CD}}) + .231695 D_1$$

(-4.273) (9.150)

$$\bar{R}^2 = .978$$

S.E. = .0389
D.W. = 1.059

These results are unsatisfactory because the Durbin-Watson statistics indicate that the hypothesis that error terms are serially independent must be rejected. When this is the case t-tests for the statistical sig-

nificance of coefficient estimates are not valid. This is because OLS estimators do not have minimum variance when error terms are serially correlated.¹

Several techniques used in attempts to remove the autocorrelation problem did not produce reliable results. Inclusion of additional yield spreads, such as the spread between the yield on three- to five-year Government securities and Q_{OTD} in the a-ratio equation, did not significantly raise D.W. statistics and in some cases resulted in wrong signs on yield-spread variables.² Other attempts to alleviate contamination from autocorrelation included the Cochrane-Orcutt technique for selecting a parameter of transformation. This resulted in an adjustment parameter approaching unity, which is equivalent to taking first differences.³ Estimations of first differences, however, produced \bar{R}^2 s ranging from .05 to .16 and D.W. statistics suggesting higher order serial correlation.⁴

¹ Potluri Rao and Roger LeRoy Miller, Applied Econometrics (Belmont, Calif.: Wadsworth Publishing Company, Inc., 1971), pp. 69-70; J. Johnston, Econometric Methods, 2nd ed. (New York: McGraw-Hill Book Company, 1972), p. 246.

² Altering the measurement of relative yields from spreads to ratios, and using alternative measures for income, reserves, and inflation, likewise, did not significantly change the nature of the results.

³ See D. Cochrane and G. H. Orcutt, "Application of Least Squares Regression to Relationships Containing Auto-correlated Error Terms," Journal of the American Statistical Association 44 (March 1949):32-61.

⁴ Stepwise regressions of error terms on lagged error terms generally suggested that higher order serial correlation was not a serious problem. F-statistics were used to test the hypothesis that $\rho_1 = \rho_2 = \rho_3 \dots = 0$ from regressions $e_t = \rho_1 e_{t-1} + \rho_2 e_{t-2} \dots$ up to six lags. Coefficients beyond ρ_1 were not significant except in the case of the t-ratio, where ρ_2 was marginally significant suggesting second-order autocorrelation. In that case F was equal to 3.995 and the critical

Estimations using the value of the dependent variable lagged one period as an explanatory variable also failed tests for serial independence of residuals. However, these equations adjusted by means of the Cochrane-Orcutt technique produced results with residuals that could be regarded as serially independent using the h-statistic as a criterion.⁵ These estimations are reported below. Rho is the final value of the parameter of autocorrelation computed by means of the Cochrane-Orcutt technique.

$$(4.5) \quad s = .023660 + .000022 \left(\frac{Y}{CPI} \right) + .000272 \dot{CPI} - .000007 D_2 \dot{CPI} \\ (1.345) \quad (1.088) \quad (1.428) \quad (-0.087) \\ - .019867 R_{dev} - .195108 (i_b - Q_{SD}) + .005772 D_1 \\ (-0.721) \quad (-3.892) \quad (2.306)$$

value of $F_{(1,70)}$ for rejection of the null hypothesis that $\rho_1 = \rho_2 = 0$ was 3.98 for a 95 percent confidence interval. Stepwise regressions of error terms on lagged error terms up to sixteen lags indicated that the first and fifteenth lags were significant determinants of e_t in the s, a, and t equations and that the first and fourteenth lags were significant determinants of e_t in the n-ratio equation.

⁵With inclusion of a lagged dependent variable, the appropriate test for autocorrelation is in terms of an h-statistic. The h-statistic is defined as

$$h = (1 - 1/2 d) \sqrt{\frac{T}{1 - T \cdot \hat{V}(\hat{\beta}_1)}}$$

where d is the Durbin-Watson statistic, T is the sample size and $\hat{V}(\hat{\beta}_1)$ is the estimated variance of the coefficient of the lagged dependent variable. The h-statistic is distributed as standard normal with mean zero and variance unity. For a 95 percent confidence interval the critical values of the h-statistic are ± 1.64 . Values of h outside this range signify rejection of the null hypothesis that errors are serially independent. (See Rao and Miller, Applied Econometrics, pp. 123-24). Values of the h-statistic computed from estimations of unadjusted equations including a lagged dependent variable ranged upward from 1.78.

$$+ .933808 s_{t-1}$$

(21.857)

$$\bar{R}^2 = .988$$

$$\text{S.E.} = .0029$$

$$h = .131$$

$$\text{Rho} = .218247$$

$$(4.6) \quad a = -.060698 + .000160 \left(\frac{Y}{\text{CPI}} \right) - .010188 \dot{\text{CPI}} + .012493 D_2 \dot{\text{CPI}}$$

(-2.950) (3.755) (-.000) (.000)

$$- .008457 R_{\text{dev}} - .351324 (i_b - Q_{\text{OTD}}) + .905035 a_{t-1}$$

(-0.237) (-3.767) (40.242)

$$\bar{R}^2 = .999$$

$$\text{S.E.} = .0043$$

$$h = .653$$

$$\text{Rho} = .310768$$

$$(4.7) \quad n = -.026621 + .000347 \left(\frac{X}{\text{CPI}} \right) + .001614 \dot{\text{CPI}} - .000387 D_2 \dot{\text{CPI}}$$

(-0.785) (0.908) (1.972) (-0.918)

$$- .004152 R_{\text{dev}} - .575827 (i_b - i_{\text{CD}}) + .917919 n_{t-1}$$

(-0.056) (-4.209) (35.585)

$$\bar{R}^2 = .997$$

$$\text{S.E.} = .0061$$

$$h = .382$$

$$\text{Rho} = .580754$$

$$(4.8) \quad t = -.095311 + .000293 \left(\frac{Y}{\text{CPI}} \right) - .000045 \left(\frac{X}{\text{CPI}} \right) + .004486 \dot{\text{CPI}}$$

(-2.007) (2.075) (-0.045) (2.929)

$$- .001107 D_2 \dot{\text{CPI}} - .028272 R_{\text{dev}} - .538240 (i_b - Q_{\text{OTD}})$$

(-1.767) (-0.288) (-2.272)

$$- .724825 (i_b - i_{\text{CD}}) + .006897 D_1 + .909013 t_{t-1}$$

(-3.452) (0.676) (28.740)

$$\bar{R}^2 = .999$$

$$\text{S.E.} = .0096$$

$$h = .699$$

$$\text{Rho} = .342063$$

One conclusion from this investigation is that the t-ratio and its

components can best be examined through a model containing the lagged dependent variable as an explanatory variable. Given this characteristic of the model, changes in the spread between yields on time deposits and other financial assets provide the most consistent explanation of changes in the level of the t-ratio and its components.

Inclusion of lagged dependent variables along with adjustment by means of the Cochrane-Orcutt technique alleviated contamination of results due to autocorrelated residuals. Of previous studies of the t-ratio cited in Chapter II, Hoffman's also used a model which included the lagged dependent variable. Neither Hosek nor Wrightsman reported D.W. statistics to indicate the nature of residuals obtained in their estimations, which did not include a lagged dependent variable.

Real income was hypothesized to have a positive influence on the t-ratio and its components. This was observed in estimations of the a-ratio and the t-ratio. The coefficient of real income was not significantly different from zero in the estimation of the s-ratio and real business sales were not statistically significant in the estimation of the n-ratio. In the s-ratio equation, real income could be picking up two countervailing forces correlated with income -- a secular effect and a cyclical effect. The secular effect would be positive, assuming savings deposits represent a "luxury" item. The cyclical effect could be positive or negative. If increases in economic activity, represented by rises in income, generate increases in demand for transactions balances, people might switch from savings accounts to demand deposits with a resulting negative effect on the s-ratio. Alternatively, if people deplete savings account balances to maintain spending growth during periods of slower

income growth, income would tend to be positively related to the s-ratio over the business cycle. Lack of significance in the coefficient for real business sales in the n-ratio estimation could mean that it is an inappropriate measure of corporate funds available for investment in short-term liquid assets. Alternatively, it could mean that such a variable is relatively insignificant in determining the n-ratio.

Inflation, measured by the six-month rate of change of the consumer price index was positive but not consistently significant in the estimations. In the estimation of the t-ratio, it was significant. In estimations of the s-ratio and the a-ratio in which $D_2 \dot{CPI}$ was excluded, the significance of \dot{CPI} increased. In the s-ratio equation the coefficient of \dot{CPI} became .000260 and the t-value rose to 1.935. In the a-ratio equation, the coefficient of \dot{CPI} became .002306 and the t-value rose to 4.025. Other coefficients remained essentially unchanged. This could mean that people made adjustments toward time and savings accounts rather quickly in the period of very rapid inflation in 1974 signified by D_2 .

The dummy variable signifying the change in Regulation Q allowing governmental units to hold savings deposits appears to be a significant determinant of the s-ratio.

The reserves variable is not significant in any of the estimations. This suggests that adjustments to other factors, namely relative yields, take place quite rapidly and there is no significant tendency for changes in the growth of reserves to have a short-run positive effect on the growth of demand deposits relative to the growth of time deposits.

Coefficients of interest rate spreads were consistently negative

and significant as hypothesized. Results obtained with regard to interest rates by and large are consistent with those obtained by Hoffman and by Hosek. In addition, the results show that each individual component of time deposits tends to be sensitive to relative yields and that the components of the t-ratio as well as the t-ratio as a whole can effectively be examined by the model estimated.

The fact that empirical models of the t-ratio which do not contain a lagged dependent variable produce serially correlated residuals suggests the possibility that a theoretically relevant variable has been left out of the models. A theoretical variable that is probably not captured adequately in the empirical model estimated in this paper or in ones specified in earlier studies is the relation between nonpecuniary yields on time deposits and demand deposits. Estimation of the empirical model was based on the assumption that nonpecuniary relative yields that were not captured by real income or inflation remained constant over the estimation period. The truth of this assumption might be questioned. For the assumption to be true, for example, requires that gift premiums for holding time deposits and compensating balance requirements did not produce changes in deposit preferences during the estimation period. Related is the possibility that there is some systematic trade-off between deposit holdings and other assets, such as currency, which is not captured by the predetermined variables in the model. In my judgment the existence of these possibilities does not seriously detract from usefulness of the model that has been estimated; nor does it imply that the general conclusions reached are not valid. Consideration of

nonpecuniary yields represents a topic for further research. Unfortunately, the data problems would be severe.

BIBLIOGRAPHY

- Annual Report of the Federal Deposit Insurance Corporation. Washington, D.C.: Federal Deposit Insurance Corporation, 1974.
- Brunner, Karl. "Monetary Analysis and Federal Reserve Policy." In Targets and Indicators of Monetary Policy, pp. 250-82. Edited by Karl Brunner. San Francisco: Chandler Publishing Company, 1969.
- Burger, Albert E. The Money Supply Process. Belmont, Calif.: Wadsworth Publishing Company, Inc., 1971.
- Cagan, Phillip. Determinants and Effects of Changes in the Stock of Money 1875-1960. New York: National Bureau of Economic Research, 1965.
- Cochrane, D. and Orcutt, G. H. "Application of Least Squares Regression to Relationships Containing Auto-correlated Error Terms." Journal of the American Statistical Association 44 (March 1949):32-61.
- Cohan, Sandra B. "The Determinants of Supply and Demand For Certificates of Deposit." Journal of Money, Credit and Banking 5 (February 1973):100-12.
- deLeeuw, Frank. "A Model of Financial Behavior." In The Brookings Quarterly Econometric Model of the United States, pp. 464-530. Edited by James S. Duesenberry, Gary Fromm, Lawrence R. Klein, and Edwin Kuh. Chicago: Rand McNally & Company, 1965.
- Dewald, William G. "Money Supply Versus Interest Rates As Proximate Objectives of Monetary Policy." The National Banking Review 3 (June 1966):509-22.
- Durbin, J. "An Alternative to the Bounds Test for Testing for Serial Correlation in Least-Squares Regression." Econometrica 38 (May 1970):422-29.
- Federal Reserve Bulletin 61 (April 1975):261.
- Feige, Edgar L. The Demand for Liquid Assets: A Temporal Cross-Section Analysis. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1964.
- Feige, Edgar L. "Alternative Temporal Cross-Section Specifications of the Demand for Demand Deposits." In Issues in Monetary Economics, Proceedings of the 1972 Money Study Group Conference, pp. 260-89.

Edited by H. G. Johnson and A. R. Nobay. London: Oxford University Press, 1974.

Friedman, Milton and Schwartz, Anna Jacobson. A Monetary History of the United States 1867-1960. New York: National Bureau of Economic Research, 1963.

Friedman, Milton and Schwartz, Anna Jacobson. Monetary Statistics of the United States: Estimates, Sources, Methods. New York: National Bureau of Economic Research, 1970.

Gilbert, Gary G. and Murphy, Neil B. "Competition Between Thrift Institutions and Commercial Banks: An Examination of the Evidence." Journal of Bank Research 2 (Summer 1971):8-18.

Gramley, Lyle E. and Chase, Samuel B., Jr. "Time Deposits in Monetary Analysis." Federal Reserve Bulletin 51 (October 1965):1380-1404.

Gurley, John G. and Shaw, Edward S. Money in a Theory of Finance. Washington, D.C.: The Brookings Institution, 1960.

Hamburger, Michael J. "The Demand for Money by Households, Money Substitutes, and Monetary Policy." The Journal of Political Economy 74 (December 1966):600-23.

Hamburger, Michael J. "Household Demand for Financial Assets." Econometrica 36 (January 1968):97-118.

Hamburger, Michael J. "Discussion Paper." In Issues in Monetary Economics. Proceedings of the 1972 Money Study Group Conference, pp. 490-94. Edited by H. G. Johnson and A. R. Nobay. London: Oxford University Press, 1974.

Heebner, Albert Gilbert. "Negotiable Certificates of Deposit: The Development of a Money Market Instrument." Ph.D. dissertation, University of Pennsylvania, 1967.

Hoffman, Stuart G. "Determination of the Money Multiplier by Component Ratio Estimation." Ph.D. dissertation, University of Cincinnati, 1975.

Hoffman, Stuart G. "Determination of the Money Multiplier by Component Ratio Estimation." Paper presented at the meeting of the Federal Reserve System's Committee on Financial Analysis, New York, N.Y., 19-20 November 1975.

Horvitz, Paul M. "Economies of Scale in Banking." Private Financial Institutions. Commission on Money and Credit. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1963.

Hosek, William R. "Determinants of the Money Multiplier." The Quarterly

Review of Economics and Business 10 (Summer 1970):37-46.

Johnson, Harry G. "Monetary Theory and Policy." The American Economic Review 52 (June 1962):335-84.

Johnston, J(ohn). Econometric Methods. 2nd ed. New York: McGraw-Hill Book Company, 1972.

Jordan, Jerry L. "The Market for Deposit-Type Financial Assets." Ph.D. dissertation, University of California, Los Angeles, 1969.

Klein, Benjamin. "Competitive Interest Payments on Bank Deposits and the Long-Run Demand for Money." The American Economic Review 64 (December 1974):931-49.

Klein, Michael A. and Murphy, Neil B. "The Pricing of Bank Deposits: A Theoretical and Empirical Analysis." Journal of Financial and Quantitative Analysis 6 (March 1971):747-61.

Lee, Tong Hun. "Substitutability of Non-Bank Intermediary Liabilities for Money: The Empirical Evidence." The Journal of Finance 21 (September 1966):441-57.

Lovati, Jean M. "The Changing Competition Between Commercial Banks and Thrift Institutions for Deposits." Federal Reserve Bank of St. Louis Review 57 (July 1975):2-8.

"Maximum Interest Rates Payable on Time and Savings Deposits." Federal Reserve Bulletin 62 (February 1976):A8.

Mueller, Eva and Lean, Jane. "The Savings Account as a Source for Financing Large Expenditures." The Journal of Finance 22 (September 1967):375-93.

Nagel, Ernst. The Structure of Science: Problems in the Logic of Scientific Explanation. New York: Harcourt, Brace & World, Inc., 1961.

Pickering, Richard C. "Changes in S & L Savings Account Structure: April-September 1974." Federal Home Loan Bank Board Journal 8 (February 1975):23-26.

Rao, Potluri and Miller, Roger LeRoy. Applied Econometrics. Belmont, Calif.: Wadsworth Publishing Company, Inc., 1971.

Rossman, Joseph E., Jr. "A Study of the Use of Negotiable Certificates of Deposits by Large U.S. Banks to Satisfy Liquidity, Profitability, and Soundness Needs." Ph.D. dissertation, Iowa State University, 1975.

Ruebling, Charlotte E. "Financing Government Through Monetary Expansion

and Inflation." Federal Reserve Bank of St. Louis Review 57
(February 1975):15-23.

- Smith, Warren L. "Time Deposits, Free Reserves, and Monetary Policy." In Issues in Banking and Monetary Analysis, pp. 79-113. Edited by Giulio Pontecorvo, Robert P. Shay, and Albert G. Hart. New York: Holt, Rinehart and Winston, Inc., 1967.
- Tobin, James. "Commercial Banks as Creators of Money." In Banking and Monetary Studies, pp. 408-19. Edited by Deane Carson. Homewood: Ill.: Richard D. Irwin, Inc., 1963.
- Tobin, James and Brainard, William C. "Financial Intermediaries and the Effectiveness of Monetary Controls." In Essays in Economics, Vol. 1, Macroeconomics, pp. 283-321. Edited by James Tobin. Chicago: Markham Publishing Company, 1971.
- U.S. Treasury Department. General Regulations With Respect to United States Securities. U.S. Treasury Department Circular No. 300, 3rd rev. (1964).
- Weintraub, Robert. "The Time Deposit - Money Supply Controversy." In Targets and Indicators of Monetary Policy, pp. 300-12. Edited by Karl Brunner. San Francisco: Chandler Publishing Company, 1969.
- Williams, John R. and Lewis, Virginia. "Changes in Time and Savings Deposits at Commercial Banks, January-April 1975." Federal Reserve Bulletin 61 (October 1975):618-24.
- Wrightsmann, Dwayne. An Introduction to Monetary Theory and Policy. New York: The Free Press, 1971.
- Zecher, Joseph Richard. "An Evaluation of Four Econometric Models of the Financial Sector." Ph.D. dissertation, Ohio State University, 1969.

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APPENDIX A.

CALCULATION OF THE MULTIPLIER WITH A GIVEN CHANGE
IN THE t-RATIOCase I

Assumptions

$$t = 2.00 \text{ (changed from 2.0454)}$$

$$B = \$116.79^1$$

$$R = \$45.29$$

$$C = \$71.5$$

$$G = \$3.8$$

$$r_{DD} = .13$$

$$r_{TD} = .036$$

Calculations

$$.13DD + .13G + .036TD = \$45.29$$

$$TD = 2.0DD$$

$$.13DD + .13(3.8) + .036(2.0)DD = \$45.29$$

$$DD = \$221.76$$

$$TD = (2.0)(\$221.76) = \$443.52$$

$$t = \frac{\$443.52}{\$221.76} = 2.0$$

$$k = \frac{\$71.5}{\$221.76} = .3224$$

¹Dollar amounts are in billions of dollars.

$$g = \frac{\$3.8}{\$221.76} = .0171$$

$$r = \frac{\$45.29}{\$221.76 + \$3.8 + \$443.52} = .0677$$

$$m = \frac{1 + .3224}{.0677(1 + 2.0 + .0171) + .3224} = 2.511$$

Case II

Assumptions

$$t = 2.0$$

$$R = \$45.29$$

$$r_{DD} = .13$$

$$r_{TD} = .036$$

$$k = .325$$

$$g = .0173$$

Calculations

$$.13DD + .13G + .036TD = \$45.29$$

$$TD = 2.0DD$$

$$G = .0173DD$$

$$C = .325DD$$

$$.13DD + .13(.0173)DD + .036(2.0)DD = \$45.29$$

$$DD = \$221.79$$

$$TD = (2.0)\$221.79 = \$443.58$$

$$G = (.0173)\$221.79 = \$3.84$$

$$C = (.325)\$221.79 = \$72.08$$

$$B = \$45.29 + \$72.08 = \$117.37$$

$$r = \frac{\$45.29}{\$221.79 + \$3.84 + \$443.58} = \frac{\$45.29}{\$669.21} = .0676$$

$$m = \frac{1 + .325}{.0676(1 + 2.0 + .0173) + .325} = 2.503$$

Case II'

Assumptions same as Case II except

$$t = 2.075$$

Calculations

$$.13DD + .13(.0173)DD + .036(2.075)DD = \$45.29$$

$$DD = \$218.90$$

$$TD = (2.075)\$218.9 = \$454.22$$

$$G = (.0173)\$218.9 = \$3.787$$

$$C = (.325)\$218.9 = \$71.14$$

$$B = \$45.29 + \$71.14 = \$116.43$$

$$r = \frac{\$45.29}{\$218.9 + \$3.787 + \$454.22} = .0669$$

$$m = \frac{1 + .325}{.0669(1 + 2.075 + .0173) + .325} = 2.491$$

APPENDIX B.

METHOD FOR ESTIMATING SAVINGS DEPOSITS

Daily average deposit data for savings deposits at all commercial banks are not published. These data used to calculate the s-ratio are estimated from published weekly data for member banks and the ratios of member bank savings deposits to total commercial bank savings deposits for mid-year and year-end dates. Daily average data for savings deposits at member banks are published in the Board of Governors "H.7" release. These data are available back through October 1968. Mid-year and year-end savings deposits of all commercial banks as well as member banks are published in the "F.R. 40" release.

Daily average savings deposits at all commercial banks were estimated by the following method.

1. Weekly averages of daily figures from the "H.7" were converted to monthly averages of daily figures.
2. Ratios of member bank savings deposits to total commercial bank savings deposits were calculated from "F.R. 40" data for mid-year and year-end dates.
3. Monthly ratios of member bank to total commercial bank savings deposits were estimated by interpolation between mid-year and year-end ratios.
4. Monthly member bank savings deposit data [from (1) above] were divided by ratios [from (3) above] for the corresponding months to estimate total commercial bank savings deposits.

Savings deposit data marked "seasonally adjusted," as in Figure 3, have been seasonally adjusted with the Census Program X=11.

APPENDIX C.

DEFINITIONS OF SYMBOLS USED IN
CHAPTER IV AND SOURCES OF DATA

- a: Ratio of other time deposits seasonally adjusted to demand deposits seasonally adjusted. Other time deposits is equal to net time deposits (total other than large CDs) seasonally adjusted less savings deposits seasonally adjusted.
Source of net time deposits and demand deposits: Federal Reserve Bulletin.
Source of savings deposits: Board of Governors of the Federal Reserve System "H.7" and "F.R. 40" releases. Data are seasonally adjusted by the use of the X-11 seasonal adjustment program.
- CPI: Consumer price index, seasonally adjusted (1967=100).
Source: Department of Labor, Bureau of Labor Statistics.
- CPI: Six-month compounded annual rates of change of the consumer price index with the resultant rate of change being placed in the terminal month.
- D₁: Dummy to signify period when a change in Regulation Q allowed governmental units to hold savings deposits.
D₁ = 1; 11/74 - 6/75
D₁ = 0; 10/68 - 10/74.
- D₂: Dummy to signify period when the rate of inflation was greater than could be anticipated.
D₂ = 1; 12/73 - 11/74
D₂ = 0; 10/68 - 11/73 and 12/74 - 6/75.
- i_b: True market yield on three-month Treasury bills computed by the following:

$$i_b = \frac{dr}{1 - (dr \cdot \frac{t}{T})}$$

where: dr = yield on discount basis
t = maturity measured in days (90)
T = 360 days.

Source for Treasury bills (discount basis): Federal Reserve Bulletin.

i_{CD} : A combination of two series.
 10/68, 7/70 - 12/75: Salomon Brothers and Hutzler 3-month certificate of deposit rate, secondary market.
 11/68 - 1/70: Regulation Q rate on 60- to 89-day CDs.
 Source for Salomon Brothers: Salomon Brothers, "Bond Market Roundup".
 Source for Regulation Q: Federal Reserve Bulletin.

n : Ratio of certificates of deposit of \$100,000 or more seasonally adjusted to demand deposits seasonally adjusted.
 Source: Federal Reserve Bulletin.

Q_{OTD} : Highest Regulation Q ceiling rates on other time deposits.
 Source: Federal Reserve Bulletin.

Q_{SD} : Regulation Q ceiling rates on savings deposits.
 Source: Federal Reserve Bulletin.

R_{dev} : Residuals from OLS regression:

$$\log \text{Reserves} = \beta_0 + \beta_1 \text{ time for } 10/68 - 6/75.$$

Reserves are defined as monetary base seasonally adjusted less currency held by the public seasonally adjusted.
 Source for monetary base: Federal Reserve Bank of St. Louis.
 Source for currency: Federal Reserve Bulletin.

s : Ratio of savings deposits seasonally adjusted to demand deposits seasonally adjusted.
 Source for savings deposits: Board of Governors of the Federal Reserve System "H.7" and "F.R. 40" releases. Data are seasonally adjusted by the use of the X-11 seasonal adjustment program.
 Source for demand deposits: Federal Reserve Bulletin.

t : Ratio of total time deposits seasonally adjusted to demand deposits seasonally adjusted.
 Source: Federal Reserve Bulletin.

Y : Personal income seasonally adjusted annual rates.
 Source: Survey of Current Business, Department of Commerce, Bureau of Economic Analysis.

X : Manufacturing and trade total sales seasonally adjusted.
 Source: Survey of Current Business, Department of Commerce, Bureau of Economic Analysis.