Working Paper 79-4

DETERMINANTS OF THE SPREAD BETWEEN TREASURY BILL AND PRIVATE SECTOR MONEY MARKET RATES

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September 1979*

*Revised April 1980

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Introduction

The purpose of this paper is to explore the reasons underlying the variable and sometimes very large differentials between United States Treasury bill rates and private sector U.S. money market rates of comparable maturity. The movement of these differentials over time is illustrated in Figure 1, which shows the spread between the average yield on prime private sector money market instruments and the market yield on Treasury bills from 1963 through 1977.[1]

There are two possible explanations for the movement in spreads between Treasury bill rates and rates on other money market instruments of equal maturity. Each explanation is consistent with a different view of the behavior of investors in the money market.[2] The first view is the "perfect substitutes" view which holds that investors arbitrage across instruments to keep yields, adjusted for risk and taxes, equal. According to this view, all sustained movements in yield spreads can be accounted for by factors such as varying risk, maturity, or tax status of securities. Observed yield spreads occur simply because calculated yield series are before-tax promised yields to maturity.

The second view of investor behavior is the "imperfect substitutes" or "preferred habitat" view. The essence of this view is that for reasons of regulation, tradition, taxation, or accessability, different investors tend to hold different types of financial instruments. As a result, changing conditions in a particular sector of the money market may influence yield spreads over a significant period of time. Of course, the two views are not mutually inconsistent and one can argue that observed yield spreads are affected by both types of influences.

The question of the determinants of the differentials between Treasury bill rates and other money market rates is not an empty one. In

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*The author would like to acknowledge the very helpful comments of an anonymous referee.

some econometric models the Treasury bill rate is the key short-term rate and other short-term rates are simply determined by the level of the bill rate. For instance, in the 1978 MIT-PENN-SSRC model the bill rate is determined in the bank reserves market, and the commercial paper rate is a linear function of the bill rate.[3] This approach implicitly assumes that the perfect substitutes theory is the correct view of yield determination in the money markets. Through a term-structure relationship, the commercial paper rate in the MPS model feeds into the corporate bond rate, which is an important determinant of real sector activity. Hence, if the perfect substitutes assumption is invalid, the model's ability to forecast economic activity is weakened.

The most common explanation of the movement in the spreads between Treasury bill and other money market rates is one consistent with the perfect substitutes view of investor behavior. According to this explanation, these spreads are caused by a cyclical risk premium pushing up the observed yields on private sector money market instruments relative to the yields on Treasury bills. However, the spreads between private sector money market rates and bill rates frequently behave quite differently than other yield spreads that isolate the influence of cyclical risk premiums. These latter spreads generally do not rise much until the onset of a recession and typically peak near the end of a recession. In contrast, the spreads between private sector money market rates and bill rates have risen well before the beginning of recessions and have generally fallen sharply prior to the end of recessions. As a simple test of this observation, the correlation coefficients for the spread between Moody's corporate Baa and Aaa bond rates and the spreads between private sector money market

rates and bill rates were calculated over the 1963-77 period shown in Figure 1. The correlation coefficient between the Moody's bond yield spread and the spread between the high grade prime commercial paper rate and the bill rate is .087. The correlation coefficient between Moody's bond yield spread and the spread between the prime CD rate and the bill rate is .135. Neither of these correlation coefficients is significantly different from 0 at the 10 percent level. Consequently, cyclically varying risk premia appear not to provide a complete explanation of the movement in the spreads between private money market and Treasury bill rates.

The rest of this paper presents an explanation of the spreads between bill yields and other money market yields that allows for the influence of preferred habitats as a determinant of those spreads. It is assumed at the outset that commercial paper, CD, and bankers acceptance rates behave in a manner consistent with the "perfect substitutes" view of the financial market. This assumption is based on the fact that the correlation coefficients between the monthly changes of any two of these three series are all .95 or higher. In contrast, the correlation coefficient between monthly changes in the bill and commercial paper rates is only .71, the correlation coefficient between monthly changes in the bill and CD rates is .76, and the correlation coefficient between monthly changes in the bill rate and the bankers acceptance rate is .78.

I. Preferred Habitats and Limited Habitats in the Treasury Bill Market

A fundamental characteristic of the bill market has been the erratic participation of the household sector. The general pattern of this participation in recent years is shown in Table 1 using annual Flow of Funds data. Column (1) of the table shows the total increase in bills outstanding net of foreign,

Federal Reserve, and the U.S. government holdings; this column represents the net flow of bills absorbed by the private domestic economy. Column (2) shows the net change in the holdings of the household sector, while column (3) shows the net change in holdings of the rest of the domestic private economy. The table illustrates that in periods of rising interest rates--1966, 1969, 1973, 1974--the household sector has typically purchased large amounts of bills while other domestic investors have decreased their holdings of bills.

The pattern of bill holdings shown in Table 1 occurs because household investment behavior has been limited by the institutional framework of the money market.[4] When interest rates rise above Regulation Q interest rate ceilings at commercial banks and thrift institutions, households naturally want to take advantage of high market yields. However, CD's are issued in minimum amounts of $100,000 and commercial paper is issued in minimum amounts of $25,000 to $100,000 and is usually traded in lots of $100,000 or more. Consequently, a large segment of the household sector has been effectively limited to purchasing bills among the money market instruments. To call this behavior on the part of households "preferred" is something of a misnomer. The phenomenon can more accurately be described as one of "limited habitat," a term to be used for the remainder of this article.

The behavior of the household sector described above is not necessarily incompatible with perfect substitution in the aggregate. The theory does require, however, that the impact of abrupt shifts in household purchases of bills on spreads between private sector and bill yields be quickly offset by the reaction of other investing sectors of the economy. The decline in the holdings of bills, shown in Table 1,

by private domestic investors other than the household sector in such periods as 1966, 1969, 1973, and 1974 confirms that these sectors have reacted to rising spreads between private sector money market rates and bill rates in those periods. Nevertheless, the levels of bill holdings of most nonhousehold sectors have remained substantial even in periods of large positive spreads between other money market yields and bill yields. To investigate this question further, it is useful to break down the nonhousehold domestic private economy into four sectors: banks, state and local governments, nonbank financial institutions, and nonfinancial corporate businesses. Table 2 shows Flow of Funds estimates of these four sectors' holdings of bills from 1972 IV, when short-term rates were at a cyclical trough, to 1974 III, when these rates reached a cyclical peak. The table shows that all four sectors reduced their holdings of bills over the 1972 IV to 1974 III period. The nonfinancial corporate sector, with the smallest holdings of bills, reduced its holdings 92.1 percent to a negligible level. State and local governments and nonbank financial institutions reduced their holdings of bills by 56.6 percent and 17.7 percent, respectively. The commercial banking sector, with the largest holdings of bills, reduced those holdings by 27.4 percent.

Why did banks, state and local governments, and nonbank financial institutions continue to hold substantial amounts of bills in the face of the large spreads between bills and private money market instruments that developed in the 1973-74 period? For the banking sector, which held 57 percent of the bills owned by domestic private investors other than households as of 1974 III, there are numerous reasons why CD's, bankers acceptances, and commercial paper are imperfect substitutes for bills. First, banks in

most states have "pledging requirements" under which they have to purchase selected assets equal to a certain percent (typically around 100 percent) of their state and local deposits.[5] In addition banks have to pledge assets against 100 percent of the noninsured portion of their Treasury deposits. Treasury bills are always acceptable pledging assets for state and local deposits while private sector money market instruments are almost never acceptable. Second, in more than one-half of the states, nonmember banks have reserve requirements that can be partially, and in some cases totally, satisfied by holding earning assets.[6] Unpledged Treasury bills are generally acceptable for this purpose, while private sector money market instruments are seldom acceptable. Third, banks acquire immediately available funds through the sale and subsequent "repurchase" of securities to businesses and state and local governments. These funds are free of reserve requirements if the securities involved are those of the United States or Federal agencies.[7] Lastly, bank regulators frequently judge a bank's capital adequacy by its ratio of equity to risky assets.[8] Risky assets are defined to be total assets less cash and U.S. government securities. Hence, the greater the holding of U.S. securities, as opposed to other money market instruments, the greater the capital adequacy ratio.

With regard to state and local governments, this sector by tradition has not been very yield conscious. More importantly, most state and local governments have legal prohibitions on the type of assets they can hold.[9] In most states the permissible types of public fund investments include time and savings deposits with instate financial institutions and U.S. government securities or guaranteed securities of U.S. agencies. The purchase of commercial paper and BAs is generally prohibited as is the purchase of out-of-state CD's. Instate CD's are generally permissible, but frequently have to

be pledged by the issuing bank with selected assets, which, as indicated above, include Treasury bills.

The nonbank financial institutions category includes numerous financial intermediaries, such as nonbank deposit institutions, credit unions, pension funds, and insurance companies. Unfortunately, the Flow of Funds does not provide estimates of short-term U.S. government holdings for each of these sectors, only for the total. Other sources seem to indicate that the nonbank deposit institutions and credit unions held a significant amount of short-term U.S. securities in 1974. These institutions have liquidity requirements that can be satisfied by holding Treasury bills. Generally, however, some other instruments, such as CDs, also qualify. Consequently, there is no readily apparent explanation for the willingness this group to hold bills in the 1973-74 period.

The argument to this point has been that, especially in periods of heavy household demand, a large percentage of bills has been held by investors for whom other money market instruments are imperfect substitutes. For these investors--many households, banks, state and local governments--bills have been the preferred or only available habitat among money market instruments for the reasons discussed above. This phenomemon might explain why these sectors hold bills in the face of yield spreads that are <u>above</u> a desired risk premium. This is not evidence, however, in support of the converse of this argument. That is, there is no apparent reason why holders of money market instruments other than bills would not switch to bills in the face of yield spreads <u>below</u> a desired risk premium. If this is the case, then the demand for bills in the aggregate would be asymmetric with respect to the spread between other money market rates and bill rates: a fall in the spread below a necessary risk premium would have a <u>greater</u> impact on demand than a rise in the spread above a necessary risk premium.

II. Specification of the Regression Model

The discussion in the previous section points to two features of the money market (through 1977) that should be taken into account in explaining historical spreads between Treasury bill and other money market yields. First, investors in the money market fall into two categories. The first type of investor (Sector 1)--corresponding roughly to a large part of the household sector--has been limited to the purchase of bills among money market instruments. The rest of the domestic economy (Sector 2) is able to purchase bills or other money market instruments.

The second feature of the market for bills and other money market instruments is the asymmetric behavior of Sector 2. On the one hand, for reasons discussed above many investors who hold bills have not viewed other money market instruments as perfect substitutes for bills. On the other hand there are no apparent non-rate factors influencing the decision to shift to bills when spreads between other money market rates and bill rates fall below the going risk premium on private sector money market instruments. Consequently, the demand for bills by Sector 2 may have been asymmetric with respect to the spread between bill rates and other money market rates.

These two features of the money market are incorporated into a simple model below. The model consists of a Treasury bill market (TB) and a market for private sector money market instruments (MM). There are two sectors on the demand side--Sector 1 and Sector 2--and the supplies of bills and other money market instruments are assumed to be exogenous with respect to the spread between bill rates and other money market rates. For Sector 1 the demand for bills is a function of the spread between the bill rate (RTB) and the Regulation Q ceiling rate on time deposits of less than a year (RTD). The demand for other money market instruments is 0 because of Sector 1's limited habitat. X_1 is a scale variable for Sector 1, to be defined below.

$$(1)\quad D_1^{TB} = a_1(RTB-RTD)X_1 + b_1X_1$$

$$(2)\quad D_1^{MM} = 0$$

Sector 2 has two sets of demand equations, one in operation when (RMM-RTB) is above the current risk premium (RSK) on MM and a second when (RMM-RTB) is below the current risk premium on MM. X_2 is a scale variable for Sector 2, defined below

$$\left.\begin{aligned}(3)\quad D_2^{TB} &= -a_2(RMM-RTB)X_2 + b_2X_2\\ (4)\quad D_2^{MM} &= c_2(RMM-RTB)X_2 + d_2X_2\end{aligned}\right\} \quad \text{when RMM - RTB > RSK}$$

$$\left.\begin{aligned} (3') \quad D_2^{TB} &= -e_2(RMM-RTB)X_2 + b_2X_2 \\ (4') \quad D_2^{MM} &= g_2(RMM-RTB)X_2 + d_2X_2 \end{aligned}\right\} \quad \text{when } RMM - RTB < RSK$$

where it is expected that $e_2 > a_2$

$g_2 > c_2$

For the case when (RMM-RTB) > RSK, the market clearing equations in the two markets are

$$(5) \quad TB = a_1(RTB-RTD)X_1 + b_1X_1 - a_2(RMM-RTB)X_2 + b_2X_2$$

$$(6) \quad MM = c_2(RMM-RTB)X_2 + d_2X_2$$

Subtracting (5) from (6) yields

$$(7) \quad MM - TB = -a_1(RTB-RTD)X_1 + (a_2+c_2)(RMM-RTB)X_2 - b_1X_1 + (d_2-b_2)X_2$$

At this point the simplifying assumption is made that the growth of the two scale variables--X_1 and X_2--is roughly proportional to growth in the volume of total money market instruments outstanding. That is, we assume

$$(8) \quad X_1 = \alpha_1(MM+TB)$$

$$(9) \quad X_2 = \alpha_2(MM+TB)$$

Substituting (8) and (9) into (7) and solving for (RMM-RTB) yields

$$(10) \quad RMM-RTB = \frac{b_1\alpha_1-(d_2-b_2)\alpha_2}{(\alpha_2+c_2)\alpha_2} + \frac{\alpha_1 a_1}{(a_2+c_2)\alpha_2}(RTB-RTD) + \frac{1}{(a_2+c_2)\alpha_2}\left(\frac{MM-TB}{MM+TB}\right)$$

For the case when (RMM-RTB)<RSK, equation 10 becomes

$$(10') \quad RMM-RTB = \frac{b_1\alpha_1-(d_2-b_2)\alpha_2}{(e_2+g_2)\alpha_2} + \frac{\alpha_1 a_1}{(e_2+g_2)\alpha_2}(RTB-RTD) + \frac{1}{(e_2+g_2)\alpha_2}\left(\frac{MM-TB}{MM+TB}\right)$$

Because (e_2+g_2) by assumption is greater than (a_2+c_2), the coefficients of the limited habitat variable, (RTB-RTD), and the relative security supplies variable, (MM-TB)/(MM+TB), are expected to be smaller in equation (10') than in equation (10). If the "perfect substitutes" view applies to the case when (RMM-RTB) < RSK, then the coefficients e_2 and g_2 would be extremely high and the expected coefficients of the limited habitat and relative security supplies variables in equation (10') would be 0.

Ideally, equations (10) and (10') would be estimated directly. Unfortunately, this can not be done because it presupposes knowledge of the current risk premium, RSK. To fix RSK at a constant level would be to assume away one of the two competing theories explaining the movement in the (RMM-RTB) spread, i.e., it would assume away the possible influence of a cyclical risk premium on the spread. For this reason an alternative estimation procedure was chosen. This procedure was to estimate the equation:

$$(10'') \quad \text{RMM-RTB} = g_{11}*K + g_{21}*(\text{RTB-RTD})*K + g_{31}*\text{RSS}*K + g_{41}*\text{RSK}*K + g_{21}*(1-K) + g_{22}*(\text{RTB-RTD})(1-K) + g_{32}*\text{RSS}(1-K) + g_{42}*\text{RSK}(1-K)$$

where RSS is now used to denote the relative security supplies variable, (MM-TB)/(MM+TB). Proxies for RSK are specified below.

K in equation (10'') is a dummy variable that takes on values of 1 in periods when the limited habitat and relative security supplies variable are putting upward pressure on (RMM-RTB) and which otherwise equals zero. Clearly, the key decision to be made in taking this approach is when to set K equal to 1. In making this decision it is useful to examine the relationship over the estimation period between the limited habitat variable, (RTB-RTD),

and (RMM-RTB). This relationship is shown in Figure 2. The figure indicates that a change in the relationship between (RTB-RTD) and (RMM-RTB) occurs in the neighborhood of (RTB-RTD) values of 1.0 percentage point. On the basis of this information, the rule chosen to select values of K was:

$$K = 1 \text{ if } (RTB-RTD) \geq c$$

$$K = 0 \text{ if } (RTB-RTD) < c$$

where c is a constant. In this framework two sets of coefficients are estimated in equation (10"): one for when (RTB-RTD) is above the constant c and one when (RTB-RTD) is below c.[10] In the regressions below values of c ranging from .5 to 1.5 are tested. In the remainder of this paper the set of time periods when K equals 1 is referred to as Regime 1 and the set of time periods when K equals 0 is referred to as Regime 2.

The expected signs of the coefficients of the limited habitat and relative security supplies variables in equation (10") are:

$$g_{21}, g_{31} \geq 0$$

$$g_{22}, g_{32} \geq 0$$

$$g_{21} > g_{22}$$

$$g_{31} > g_{32}$$

As before, the impact on the spread of the independent variables is assumed to be asymmetric. In the extreme case where, risk aside, bills are perfect substitutes for other money market instruments, the expected value of g_{22} and g_{32} would be 0, since movement in the spread below the going risk premium resulting from low values of the independent variables would quickly be offset by arbitrage activity of investors switching out of private sector money market instruments into bills.

The expected signs of the coefficients of RSK are:

$$g_{41}, g_{42} \geq 0$$

$$g_{42} \geq g_{41}$$

The expected relative magnitude of the coefficients of RSK depends on the coefficients of the other variables. If the coefficients of (RTB-RTD) and RSS are zero in both regimes, then RSK is the only factor affecting the yield spread in both regimes and we would expect the two coefficients of RSK to be equal. On the other hand if the coefficients of (RTB-RTD) and RSS are positive in Regime 1, then movements in RSK may have little or no influence over the (RMM-RTB) spread in that period because, as hypothesized, the spread may be above the required risk premium.[11]

III. Empirical Results

Before proceeding to the estimation of equation (10"), two matters with respect to the measurement of the relative security supplies variable, RSS, have to be discussed, and a proxy to pick up the possible influence of a cyclical risk premium on the spreads between bill rates and private sector money market rates needs to be specified. RSS is constructed as

$$\frac{MM-TB}{MM+TB} = \frac{CD+CP+BA-TB}{CD+CP+BA+TB}$$

where CP = commercial paper

CD = negotiable CD's of weekly reporting banks

BA = bankers acceptances of domestic nonfinancial business

TB = Treasury bills, net of foreign, Federal Reserve, and U.S. government holdings

All four series are end-of-quarter data from the Flow of Funds.[12] The first question with respect to relative security supplies, is whether to use seasonally adjusted or unadjusted data. A view that has received support in the financial press is that the impact of seasonal movements in the supply of bills has created seasonal movements in the spreads between private money market rates and bill rates.[13] Lawler [11] has provided

strong evidence that (1) there has been a very definite seasonal in the level of spreads between private sector yields and bill yields and (2) this seasonal has been closely related to the seasonal in the supply of bills by the Government.

This raises the question as to whether the relative security supply variable should be constructed using unadjusted data or seasonally adjusted data with quarterly seasonal dummies. Since there is no seasonal in the Flow of Funds CD data and since the seasonals in the commercial paper and bankers' acceptances data are minor, this amounts to asking whether the impact on the yield spread of the seasonal component of the movement in bills should be any different than the impact of the nonseasonal component. There is no compelling reason why these components should be different, although one possible argument is that the impact of the seasonal component should be less since it is anticipated. A response to this argument is that the nonseasonal movement in bills is also anticipated. Numerous specialists in the financial markets forecast Federal borrowing activity and these forecasters focus on total financial needs, not just seasonal needs. Consequently, unadjusted data are used in the regressions below.

The second issue concerning RSS is the exclusion of holdings of the foreign sector. The assumption made here is that purchases of U.S. money market instruments by the foreign sector are exogenous with respect to the spread between the bill rate and other U.S. money market rates. The great bulk of foreign holdings of U.S. money market instruments are Treasury bills. Foreign Treasury bill purchases are completely dominated by foreign central bank purchases related to exchange rate support operations. These central banks confine their activity to bills. As a result their purchase

of bills is not sensitive to the relative yields on bills versus other money market instruments. Foreign holdings of bankers acceptances in the Flow of Funds coincide closely with foreign supplies so here too the assumption that these holdings are exogenous with respect to the spread between bill rates and other money market rates appears appropriate. The Flow of Funds lists no foreign holdings of U.S. commercial paper. The main problem with the exogeneity assumption occurs with CDs. Flow of funds data show a significant amount of foreign time deposit holdings ($20.5 billion at the end of 1977). Unfortunately, there is no breakdown of these time deposits into CD and non-CD components. Consequently, some foreign holdings of CDs may be left in the RSS variable.

Two proxies are used for RSK in an attempt to capture any impact of cyclically varying risk premia on the spread between the private money market and bill rates. These are the percentage change in real GNP and MOOD, a consumer sentiment variable used by Jaffee [10].

The private sector money market rate used in this study is an average of the prime CD rate, the high-grade prime commercial paper rate and the yield on prime bankers acceptances. These rates, taken from Salomon Brothers An Analytical Record of Yields and Yield Spreads, are averages of beginning and end-of-month rates. The market yield on Treasury bills is a daily average rate. Quarterly rates used in the study are averages of monthly rates. All yields are calculated on a 365-day bond equivalent basis and are averages of three- and six-month rates.[14] Because the Salomon Brothers' CD rate series does not begin until 1962, the period of analysis is restricted to 1963 I to 1977 IV.[15] The estimation period ends in 1977 because of institutional changes in the money market in 1978 and 1979 that expanded the options available to the household sector. These changes are discussed below.

When the regressions in this section were initially run, the Durbin-Watson statistics were in a range of 1.0 to 1.3. Consequently, the regressions were rerun using generalized least squares under the assumption of first order autocorrelation in the residuals.[16] Both current and lagged values of the limited habitat variable were tested in the regressions. In none of the equations did MOOD enter with the expected sign. Consequently, the reported regressions do not include this variable.

To establish a standard of comparison, equation (10") was first run without breaking the sample into two periods (i.e. with K=1 in all periods). The regression results are reported in equation (1) of Table 3. The results provide support for the habitat model. The coefficients of both the limited habitat and relative security supply variables are significant at the 5 percent level using a one-tail test. The coefficient of the percentage change in real GNP (GNP) is zero.

The asymmetric version of the habitat model was tested with values of c of .5, .75, 1.0, 1.25, and 1.5. The value of c for which the sum of squared residuals (SSR) was the lowest was 1.0. This value for c set K equal to 1 in 20 quarters, including 1969 I-IV, 1970 I-IV, 1973 I-IV, 1974 I-IV, 1975 I, 1975 III-IV, 1977 IV. There was only a slight rise in the SSR when c was set at 1.25 percentage points (K=1 in 18 quarters) or when c was set at .75 (K=1 in 23 quarters). The SSR rose more sharply as c was raised to 1.5 (K=1 in 15 quarters) or lowered to .5 (K=1 in 26 quarters).[17]

The regressions results, reported in equation (2) of Table 3, provide support for the asymmetric version of the habitat model. When K=1 (i.e. when RTB-RTD $\geq$ 1.0), the coefficients of the limited habitat and relative security supplies variables are positive and significant at the 5 percent level. Furthermore, the coefficient of the RSK proxy is 0. When K=0 (i.e. when

RTB-RTD < 1.0), the coefficients of the limited habitat and relative security supplies variable are very small and not significant. In this regime the coefficient of the RSK proxy is negative (actually positive, since a decline in the growth rate of real GNP implies an increase in RSK) and significant at the 10 percent level using a one-tail test.

The regressions in Table 3 were also run with the CD rate minus the Treasury bill rate as the dependent variable. As expected, given the assumption that CDs, bankers acceptances, and commercial paper are "perfect substitutes," the results were virtually the same as those reported in Table 3.

IV. Developments in 1978 and 1979 Affecting Short-Term Yield Spreads

Two major developments greatly changed the institutional environment in the United States money market in the 1978-79 period of rising interest rates. The first was the introduction at the deposit institutions in June 1978 of "money market certificates" with Regulation Q ceiling rates tied to the six-month Treasury bill rate. By February 1980, $306.7 billion of these certificates were outstanding. The second major institutional development was the rapid growth of money market mutual funds. From the beginning of 1978 through February 1980 these funds grew from $3.9 billion to $56.7 billion.

In the context of the framework presented in this paper, the introduction of money market certificates and the rapid growth of money market funds could be expected to diminish the spreads between private sector money market rates and bill rates in a period of high interest rates in two ways. First, by tying the six-month time deposit ceiling rate to the bill rate the money market certificates directly affect the level of the limited habitat variable. That variable was roughly 0 from mid-1978

through the first quarter of 1979. In the absence of money market certificates, the limited habitat variable would have risen to over 400 basis points by the first quarter of 1979, thereby greatly increasing the household sector's demand for bills.[18]

Second, the rapid growth of the money market funds can be expected to diminish the coefficients of the limited habitat and relative security supply variables for two reasons. First, these funds introduce a third alternative to those who previously were limited to deposits or bills. In periods of rising spreads between private sector rates and bill rates, the yield on many money market funds will rise relative to the yield on bills. In these circumstances households will now have the option of switching out of bills into money market funds. Furthermore, money market funds are a new sector that is highly sensitive to yield spreads.[19] That is, with a few exceptions, they are institutions for whom the "perfect substitutes" view of investor behavior is probably quite accurate. Consequently, the aggregate substitution of private sector money market instruments for bills in period of rising spreads should be greater than in the past.

If the general explanation for the observed yield spreads between bill rates and the money market rates presented in this paper is correct, it can be expected for the reasons presented in this section that these spreads will not again reach the levels of 1974.[20] In contrast, if a cyclical risk premium has been the driving force behind the spreads, there is no reason why they will not again rise to past levels.

Summary and Conclusions

This article has provided evidence that (1) the limited habitat of the household sector in the money market, (2) the preferred habitats of

other sectors such as commercial banks and state and local governments, and (3) relative security supplies have combined to cause yield spreads between bill rates and private sector money market rates to move substantially over time. The major channel underlying the large and variable spreads between bill rates and private sector money market rates has occurred when market yields rise relative to maximum time deposits yields. In such periods households, which have had limited access to other money market instruments, have greatly increased their demand for Treasury bills. Other sectors have reacted in varying degrees to the increasing differential between private sector money market rates and bill rates by decreasing their holdings of bills, but the reaction in the aggregate has been insufficient to eliminate the differential.

While evidence has been presented that private sector money market instruments have been imperfect substitutes for bills, there appears to be little support for the converse of this argument. Hence, on the one hand, the "preferred habitat" view of investor behavior is helpful in explaining the behavior of spreads between private sector money market yields and bill yields when these spreads rise above a desired risk premium. On the other hand the "perfect substitutes" view of investor behavior appears to hold in the aggregate when forces are putting downward pressure on the spread to move below a desired risk premium. As shown in Chart 1, this behavior has created a floor under which the spreads between private money market rates and bill rates do not fall.

Finally, institutional developments in the United States in the late 1970's have fundamentally changed the environment in which short-term yield relationships are determined. The introduction of money market certificates and the rapid growth of money market funds should have two effects. First,

they should prevent the limited habitat variable from rising in periods of rising market rates. Second, the presence of money market funds should increase the amount of substitution in the aggregate between bills and private sector money market instruments in periods when private sector rates rise relative to bill rates. Both of these developments should work to prevent spreads between bill rates and private money market rates from approaching past peak levels.

FOOTNOTES

1. The 1963 to 1977 period is used throughout the paper. As will be explained in detail later in the paper, the beginning of this period was chosen because of data availability, while the end was chosen due to institutional changes in the money market in 1978 and 1979 that affect the arguments presented in the paper. The yield series in Figure 1 are also described later in the paper.

2. These alternative views have been described repeatedly elsewhere. See, for instance, Roley [14], Jaffee [10], and Cook and Hendershott [5].

3. This process is described in detail in Crews [6].

4. It will be argued later, however, that institutional changes in 1978 have occurred that have largely eliminated this limitation.

5. For a description of these requirements, see Haywood [8], the Ad Hoc Subcommittee on Full Insurance of Government Deposits [1], and the Advisory Commission on Intergovernmental Relations [2].

6. Gilbert and Lovati [7] provide a state by state description of these requirements.

7. See Lucas [13].

8. See Summers [16].

9. These prohibitions are described in detail in [3].

10. This would be a relatively simple application of splined regression [15] were it not for the fact that there is more than one independent variable in equation (10"). There is no a priori reason for making the switching rule dependent on the behavior of (RTB-RTD) rather than RSS, other than the fact that (RTB-RTD) experiences very sharp cyclical movements, while RSS moves gradually over time.

11. A factor ignored throughout this discussion is the status of interest on Federal securities as exempt from state (and local) income taxes. It is probable that this status did not influence the (RMM-RTB) spread in either of the regimes discussed in the paper. In Regime 1 households, who do not have access to other money market instruments, are the net purchasers of Treasury bills. In Regime 2, financial institutions, state and local governments, and to a lesser extent nonfinancial corporations, are the net purchasers of Treasury bills. State and local governments do not pay state and local taxes. Financial institutions in 20 to 25 percent of the states pay taxes on net worth or capital, as opposed to income. In most of the other states financial institutions do pay a tax related to income. However, in almost all cases this tax is labelled a "franchise" or an "excise" tax. By designating the tax this way, states bring interest income from Federal securities under the income tax. In some states nonfinancial corporations also pay a franchise or excise tax, although in other states they do pay a true "income" tax. The one combination of circumstances in

which one might expect the tax status of Treasury bills to affect the (RMM-RTB) spread would be if households were heavy net purchasers of bills and if households had access to private sector money market instruments. It is argued later in the paper that this set of circumstances characterized the late 1970's.

12. The specific Flow of Funds data used to construct (MM-TB) was:

893169105	Total Commercial Paper Outstanding
+ 723131403	Total CDs Oustanding
+ 123169605	Bankers Acceptances of Domestic Nonfinancial Businesses
- 873061215	Domestic Private Holdings of Treasury Bills

13. For instance, this thesis has been repeatedly expounded in Salomon Brothers' Comments on Credit.

14. The average of the three- and six-month rates, as opposed to one or the other, is used in the paper because the relative magnitude of the (RMM-RTB) spread at the three- and six-month maturities has varied substantially; that is, the yield curves for RMM and RTB behave differently over the sample period. The reason for this is an interesting question in itself. A strong possibility is that expectations of bill rate movements are influenced by the current relationship of bill rates to other money market rates. In any case since there was no reason to choose the three-month maturity over the six-month maturity, or vice versa, a simple average of the two was used.

15. Lawler [12] has argued that the correct dependent variable to use in default risk regressions is the "adjusted" yield spread, (RMM-RTB)/(1+RMM), where all interest rates are measured in fractions. This measure is constant given a constant probability of default at maturity. However, when both securities in question are very low risk, such as in the present case, it makes very little difference whether the spread or the adjusted spread is used. For instance, the spread rises from 22 basis points in the fourth quarter of 1965 to 310 basis points in the third quarter of 1974. The adjusted spread rises from 22 basis points to 302 basis points over the same period, only a difference of 8 basis points. The regression results with the two measures are virtually identical. Hence, the results with the spread as the dependent variable are reported in this paper.

16. There is no a priori reason to expect the spread between private sector money market rates and Treasury bill rates to affect the level of relative security supplies, since neither the Federal government nor the private sector can switch from supplying Treasury bills to supplying private sector money market instruments, or vice versa, in response to changing interest rate spreads. Hence, the assumption of one-way causality running from relative security supplies to the interest rate spread is valid.

17. K was set equal to 1 if the current or lagged values of (RTB-RTD) were greater than or equal to c. The SSR in the five cases were c=1, 3.836; c=1.25, 3.864; c=.75, 4.014; c=1.50, 4.049; c=.50, 4.588.

18. According to Winningham [17, p. 28], as of March 1979 roughly $17.7 billion of the funds invested in money market certificates was drawn from sources other than deposits at banks and the thrift institutions. It is reasonable to assume that in the absence of money market certificates (and money market funds), most of this $17.7 billion would have gone into the Treasury bill market.

19. See Cook and Duffield [4].

20. In 1978 and 1979 the (RMM-RTB) spread averaged 71 basis points and 95 basis points, respectively. Interestingly, the spread between RMM and RTB jumped sharply in the period immediately following the imposition on March 15, 1980 of a 15 percent reserve requirement on assets above a base level at money market funds. In the five weeks following March 15 the spread between the three-month Treasury bill rate and the three-month prime CD rate, which had been at a level of about 1 percentage point, rose to 235 basis points (Wall Street Journal rates). The data on noncompetitive bids at Treasury bill auctions indicates a sharp rise in the purchases of bills by individuals over the same period. In the 10 weekly auctions prior to March 15 the average amount of noncompetitive awards was 20.0 percent. In the five weekly auctions following march 15 the average amount of noncompetitive awards jumped to 27.6 percent. This translates into an increased demand for bills by individuals of over $500 million per week.

Table 1

DOMESTIC PRIVATE HOLDINGS OF TREASURY BILLS
(Annual changes in millions)

	Total Domestic Private	Household Sector	All Others
1963	- 3129	3706	- 6835
1964	2429	- 487	2916
1965	348	2210	- 1862
1966	- 2542	1235	- 3777
1967	4217	- 387	4604
1968	9119	6866	2253
1969	7049	8951	- 1902
1970	- 4551	-13707	9156
1971	-17922	-12473	- 5449
1972	11437	1231	10206
1973	5821	15987	-10166
1974	2122	10439	- 8317
1975	45599	4814	40785
1976	12309	- 9343	21652
1977	10283	16768	- 6485
1978	- 1533	10694	-12227
1979 III	34458	25083	9375

Source: Flow of Funds, Board of Governors of the Federal Reserve System. The Flow of Funds code numbers are: 873061215 Total Domestic Private
153061215 Household Sector

Table 2

DOMESTIC PRIVATE HOLDINGS OF TREASURY BILLS
(Quarterly levels in millions)

	Total Domestic Private	Households	Commercial Banks	State and Local Governments	Private Nonbank Financial Institutions	Nonfinancial Corporate Business
1972 IV	74859	9740	30808	18144	10413	5754
1973 I	74723	14486	26868	18434	9982	4953
1973 II	73605	17334	26227	16756	9740	3548
1973 III	74225	23775	24381	16035	9423	611
1973 IV	80680	25727	28255	16150	9666	882
1974 I	84072	29408	28182	17225	8964	293
1974 II	73546	32994	22706	10165	7453	228
1974 III	77205	37938	22361	7880	8572	454
1974 IV	82802	36166	26943	8982	10095	616

Source: Flow of Funds, Board of Governors of the Federal Reserve System. The Flow of Funds code numbers are:

873061215	Total Private Domestic
153061215	Households
763061215	Commercial Banks
213061215	State and Local Governments
693061215	Private Nonbank Financial Institutions
103061211	Nonfinancial Corporate Business

Table 3

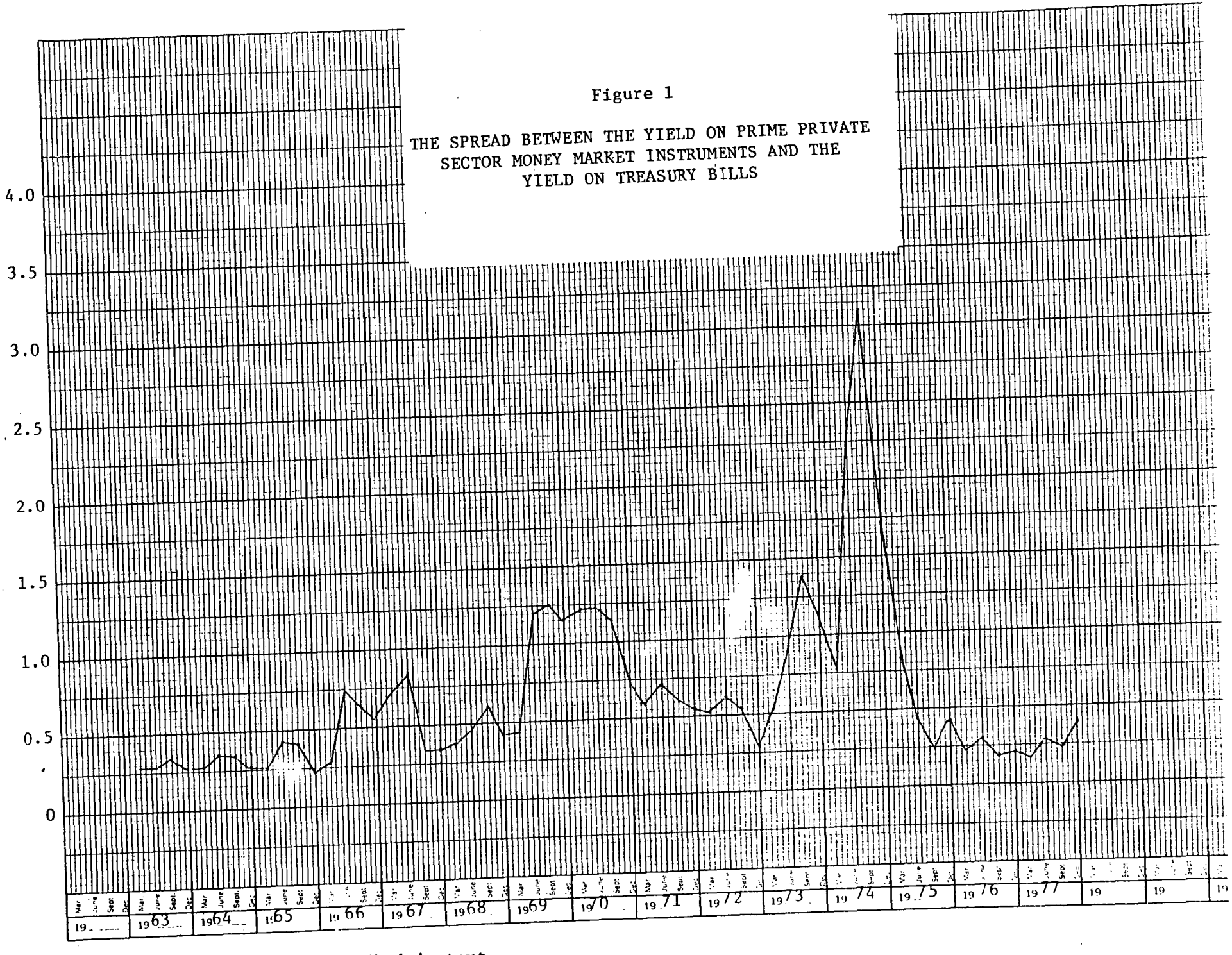
SHORT-TERM YIELD SPREAD REGRESSIONS

Dependent Variable	Independent Variables					Summary Statistics			
	Constant	LH	LH(-1)	RSS	GNP	$\bar{R}^2$	SE	ρ	D.W.
(1) RMM-RTB	.60	.17	.12	.56	-.00	.57	.35	.52	1.64
	(5.23)	(2.58)	(1.64)	(1.75)	(.13)				
(2) RMM-RTB (c=1.0)									
K	-.08	.41	.22	.82	.00				
	(.48)	(4.64)	(2.19)	(2.04)	(.01)				
1-K	.60	-.11	.04	.30	-.03	.73	.28	.43	1.73
	(4.79)	(1.11)	(.40)	(1.13)	(1.60)				

Note: t-statistics are in parentheses. The SE and $\bar{R}^2$ are for the untransformed observations. The estimation period covers 60 quarters from 1963 I through 1977 IV.

Figure 1

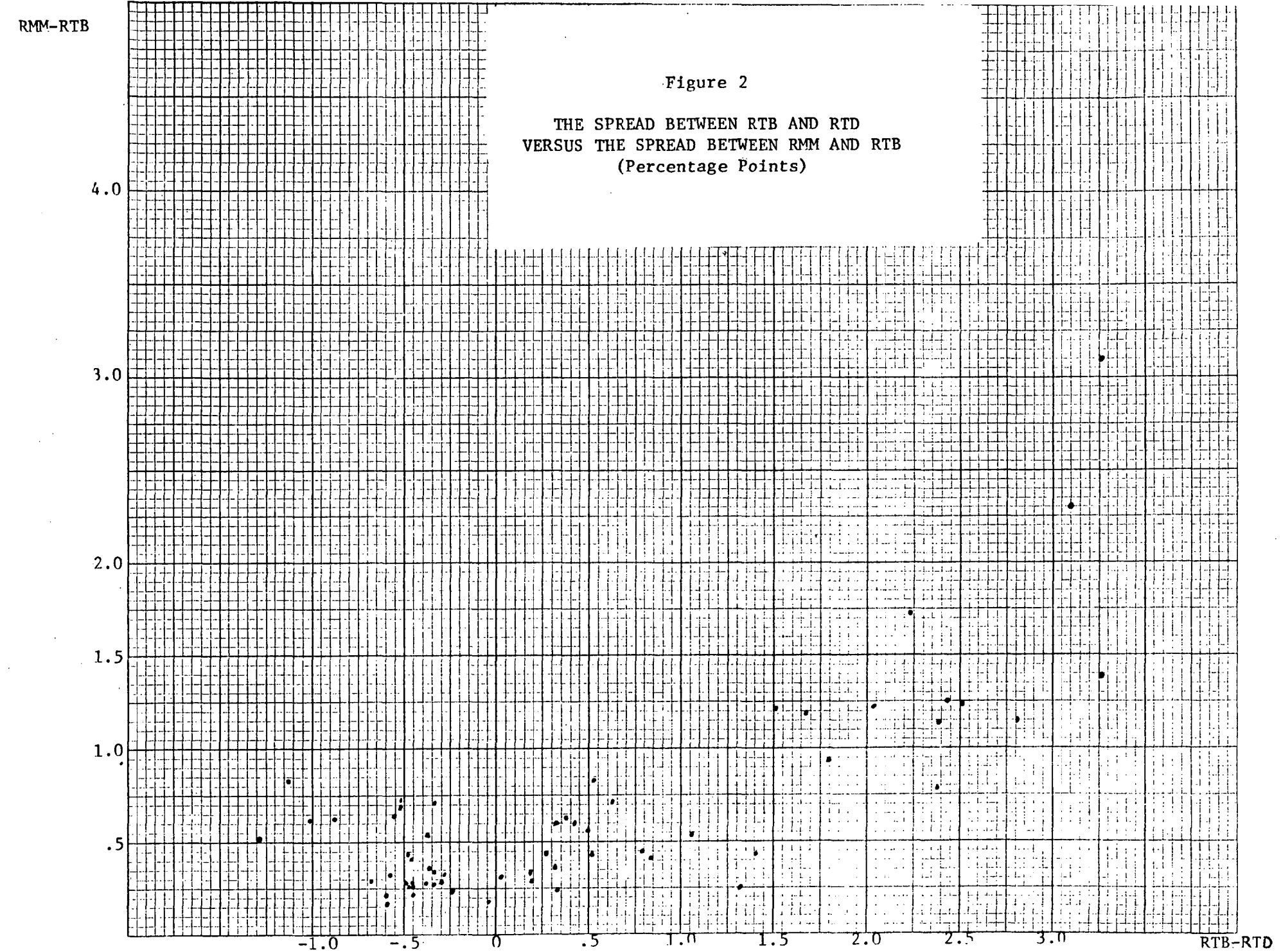
THE SPREAD BETWEEN THE YIELD ON PRIME PRIVATE SECTOR MONEY MARKET INSTRUMENTS AND THE YIELD ON TREASURY BILLS



Note: Yield series are described in text.

Figure 2

THE SPREAD BETWEEN RTB AND RTD
VERSUS THE SPREAD BETWEEN RMM AND RTB
(Percentage Points)



REFERENCES

1. Ad Hoc Subcommittee on Full Insurance of Government Deposits, Conference of Presidents, Federal Reserve System, Final Report and Recommendations, Washington, D. C. (September 4, 1979).

2. Advisory Commission on Intergovernmental Relations, The Impact of Increased Insurance on Public Deposits, Washington, D. C., Government Printing Office (January 1977).

3. _____. Understanding State and Local Cash Management, Washington, D. C., Government Printing Office (May 1977).

4. T. Q. Cook and J. G. Duffield, "Money Market Mutual Funds: A Reaction to Government Regulations or a Lasting Financial Innovation?" Federal Reserve Bank of Richmond Economic Review, (July/August 1979).

5. _____and P. H. Hendershott, "The Impact of Taxes, Risk and Relative Security Supplies on Interest Rate Differentials," Journal of Finance, (September 1978), pp. 1173-1186.

6. J. M. Crews, "Econometric Models: The Monetarist and Non-Monetarist Views Compared," Federal Reserve Bank of Richmond Monthly Review, (February 1973), pp. 3-16.

7. R. A. Gilbert and J. M. Lovati, "Bank Reserve Requirements and Their Enforcement: A Comparison Across States," Federal Reserve Bank of St. Louis Review, (March 1978), pp. 22-32.

8. C. F. Haywood, The Pledging of Bank Assets: A Study of the Problem of Security for Public Deposits, Association of Reserve City Bankers, Chicago, (1967).

9. P. H. Hendershott and D. S. Kidwell, "The Impact of Relative Security Supplies: A Test with Data from a Regional Tax-Exempt Market," Journal of Money, Credit and Banking, (August 1978).

10. D. M. Jaffee, "Cyclical Variations in the Risk Structure of Interest Rates," Journal of Monetary Economics, (July 1975), pp. 305-325.

11. T. A. Lawler, "Seasonal Movements in Short-Term Yield Spreads," Federal Reserve Bank of Richmond Economic Review, (July/August 1978), pp. 10-17.

12. _____, "Yield Spreads, Relative Yield Spreads and Default Risk," The Financial Review, (Winter 1980), pp. 55-60.

13. C. M. Lucas, M. T. Jones, and T. B. Thurston, "Federal Funds and Repurchase Agreements," Federal Reserve Bank of New York Quarterly Review, (Summer 1977), pp. 33-48.

14. V. V. Roley, "Federal Debt Management Policy: A Re-Examination of the Issues," Federal Reserve Bank of Kansas City Economic Review, (February 1978), pp. 14-23.

15. P. L. Smith, "Splines as a Useful and Convenient Statistic Tool," The American Statistician, (May 1979), pp. 57-62.

16. B. J. Summers, "Bank Capital Adequacy: Perspectives and Prospects," Federal Reserve Bank of Richmond Economic Review, (July/August 1977), pp. 3-8.

17. J. S. Winningham, "The Effects of Money Market Certificates of Deposit on the Monetary Aggregates and Their Components: An Empirical Investigation," Federal Reserve Bank of Kansas City Economic Review, (July/August 1979).