Deposit Mix at Commercial Banks and Monetary Policy

by

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The Federal Reserve Board's official acceptance of monetary aggregates as part of their policy guidelines will fail to silence many of its critics. By stating its objectives in the dual terms of total bank credit and the money supply it has implied a rejection of the most popular simplifications of monetary policy [2] [3]. By refusing to accept total bank credit as the sole aggregate guide, the Board has in effect rejected the broad definition of the money supply. By refusing to accept the narrow money supply as the only aggregate criterion, it has also rejected the view that time and savings deposit growth can be ignored in formulating monetary policy. It has taken an eclectic position that recognizes the potential importance of changes in time and savings accounts without giving them equal status as part of the money supply.

The Board's position focuses attention on the practical complexities for monetary policy that arise when many different types of bank and nonbank instruments are close substitutes for money and for each other. The implications for total bank credit of the substitution of one type of bank account for another are fairly well understood. But the implications for the total supply of credit of the substitution of bank deposits for nonbanks savings accounts or money market instruments are less well understood.

Two types of substitution effects can be identified in the literature and in the implied assumptions of policy debates [8] [9]. The first involves only internal shifts within the banking system by the substitution of time or savings accounts for demand accounts. Under the existing system of differential reserve requirements, any shift from one reserve classification to another permits changes in total bank credit. If these changes are

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independent of supplies of credit in nonbank markets, the change in total bank credit results in a corresponding change in the total supply of credit. The significant economic impact of this type of substitution appears to be the change in bank credit rather than the change in the composition of bank deposits.

Proponents of the broad definition of the money supply and of the bank credit proxy as guidelines for monetary policy implicitly accept this description of the effects of changes in the deposit mix at commercial banks. Both positions assume that changes in time or savings accounts at banks have the same effect on the level of national income as a similar change in demand accounts (i.e. $\partial y/\partial T = \partial y/\partial D$).

Competitors of commercial banks view the growth of bank time and savings accounts in a somewhat different way. They see the process as the diversion of funds from nonbank savings channels into banking channels. This shift may reflect differential rates or other factors that affect depositors' preferences. But in either event, it implies an inverse relationship between nonbank savings (S) and bank time and savings accounts (T) (i.e. $\partial S/\partial T < 0$). Under differential reserve requirements,the change in bank credit will be smaller than the amount involved in the shift and the net change in the total supply of credit will be inversely related to the change in bank credit.

Despite the differences in the effects of the two types of substitution, they show up in precisely the same way in aggregate banking data. Every increase in a bank time or savings accounts, except those involving currency, is accompanied by a transfer from a demand account merely because checks are used as the means of making the transfer. This relationship between demand and time accounts is reflected in the reserve equality:

$$R - E = mD + tT \qquad (1)$$

Where: R = total bank reserves
E = excess reserves
D = demand deposits
T = time and savings deposits
m and t = required reserve ratios on demand and time deposits

The implications of the two types of substitution can be illustrated by treating national income as a function of bank demand (D) and time accounts (T) and of nonbank sources of credit (S) where the two types of bank accounts are interrelated by equation (1).

$$Y = f(D,T,S) \qquad (2)$$

The derivative of income with respect to time deposits can be used to illustrate the implications of different assumptions.

$$dY/dT = \partial Y/\partial D \cdot dD/dT + \partial Y/\partial T + \partial Y/\partial T \cdot dS/dT \qquad (3)$$

The derivative of D with respect to T in the first term on the right hand side of (3) reflects the interaction of demand and time deposits that is internal to the banking system. This term will be the same for both types of substitution effects. The first substitution effect assumes that the changes in time accounts are independent of nonbank credit sources so that the last term of equation (3) will be zero.

The second type of substitution effect, however, implies an inverse relationship between time accounts and nonbank credit sources. Under this assumption, the derivative of S with respect to T will be equal to minus one.

Under the assumptions of the first type of substitution, equation (3) becomes:

$$dY/dT = \partial Y/\partial D \cdot dD/dT + \partial Y/\partial T \qquad (4)$$

Under the assumptions of the second type of substitution, equation (3) becomes:

$$dY/dT = \partial Y/\partial D \cdot dD/dT + \partial Y/\partial T - \partial Y/\partial S \qquad (5)$$

These equations can be simplified further by a number of other commonplace assumptions. The broad money supply and bank proxy approach both assume that the partial derivatives of Y with respect to D and T are equal. If we set the partial derivative of Y with respect to D equal to unity, equation (4) becomes:

$$dY/dT = dD/dT + 1 \qquad (6)$$

When total and excess reserves are held constant, the derivative of D with respect to T from equation (1) is negative and equal to the ratio of the reserve requirements.

$$dD/dT = -t/m \qquad (7)$$

When equation (7) is substituted into equation (6), the derivative of Y with respect to T under the first type of substitution effect becomes:

$$dY/dT = 1 - t/m \qquad (8)$$

If we assume that the partial derivatives of Y with respect to T and S are equal and substitute equation (7) into equation (5), the derivative of Y with respect to T under the second type of substitution effect becomes:

$$dY/dT = -t/m \qquad (9)$$

Equations (8) and (9) give a quite different picture of the potential effects of a given change in bank time accounts. The income effects of an increase in bank time deposits can theoretically range from a positive value of something less than unity to a negative value.

This illustration was designed to give some conception of the range of possible effects rather than to make judgments about the validity of the assumptions underlying the limiting positions. In the absence of good evidence of the effects of changes in the deposit mix, the Federal Reserve Board appears to have good grounds for rejecting simplified guidelines. But the illustration also suggests that the Board's controls over the deposit mix cannot be exercised very effectively unless something is known about the type of substitution that can be expected. This paper describes an attempt to measure the relative importance of these two types of substitutions.

Measuring the Impact of Changes in Time Deposits

By using the income equation of exchange, the factors affecting the nominal level of income can be classified into those affecting the money supply and those affecting the rate at which it is used. Both types of substitution affect the money supply in the same way. Any differential effects between the two types of substitution will have to appear as differences in the rate at which the money supply is used.

In the income equation of exchange,

$$Y = MV \qquad (10)$$

Y is income in current dollars, V is the velocity of circulation of money, and M is the money stock and M = D + C, with D being demand deposits and C the amount of currency in circulation. If it is assumed that M and V are functionally related to other variables, including time deposits at banks (T), then

$$\partial Y/\partial T = M\partial V/\partial T + V\partial M/\partial T \qquad (11)$$

Further, if it is assumed that the amount of currency changes proportionately with demand deposits, a substitution from equation (7) is suggested:

$$\partial Y/\partial T = M\partial V/\partial T - V\ t/m \qquad (12)$$

The last term of equation (12) is independent of the type of substitution that leads to the change in time deposits. The value of first term, however, will be affected by the type of substitution. If the partial derivative of velocity with respect to time deposits can be disentangled from the multiplicity of factors affecting velocity, it should give us some indication of the type of substitution that has been most important in time deposit changes and in the impact of these changes.

A model was developed to make the estimates for this equation as part of a structural system. Since money market adjustments occur quite rapidly, the model was designed to deal with monthly changes. The model was based on the equation of exchange with the level of income determined by the supply of money (M) and the demand for money as reflected in the velocity of circulation of money (V). Since the principal objective of the model was to observe the effects of changes in bank time deposits, the actions of the monetary authorities and events in the real sectors of the economy were treated as exogenous to the system. The impact of the monetary policy was introduced into the system by treating changes in member bank reserves (adjusted for the effects of changes in reserve requirements) and the ceiling rate on time and savings accounts as exogenous variables. The effects of exogenous events from nonfinancial sectors were introduced by assuming that changes in real demand would be reflected in the demands for primary credit in the form of bank loans and new issues of securities. However, the new issues variable did not significantly affect the results and was omitted from the final model. The exogenous influence of changes in expectations and in the use of funds in secondary trading markets was introduced by using the volume of security trading on the New York Exchange as a exogenous variable.

The model used the differential form of the income equation of exchange as a definitional equation:

$$\Delta Y = \Delta M V_{-1} + \Delta V M_{-1} + \Delta V \Delta M \qquad (13)$$

The other variables were introduced into the system through equations explaining changes in supply of money (ΔM) and changes in the velocity of circulation (ΔV). The structural equations of the system contain seven equations for the seven endogenous variables. Changes in time deposits (ΔT), changes in currency in circulation (ΔC), and the short-term interest rate (r) were estimated separately in the system by individual equations. Dummy variables were used to introduce seasonal influences. The structural equations were estimated by the method of two stage least squares. The structural and reduced form equations are shown in Table 1.

Behavior of the Model

The model produced encouraging results. Each of the structural equations, with the exception of bank time deposits, had R^2s of better than .80 and the signs of the coefficients corresponded to the theoretical expectations. The predicted values of monthly changes in income showed a close relationship to the actual changes (R^2 = .8545).

The difficulty experienced in estimating changes in bank time accounts may reflect the nature of the data used for the time and savings deposit rates. Both series were developed from interpolations of annual data. Thus, the role of short-run changes in preferential rates on special types of accounts which probably play a role in time deposit shifts were not reflected in these variables. The signs of the variables corresponded to expectations and the coefficients were significant. Changes in time deposits were positively related to the bank rate on these accounts and negatively related to rates on 3 month Treasury bills and the rates paid on savings accounts at other institutions.

The equation used to estimate the change in demand deposits supported the theoretical model. The coefficients in this equation provide direct estimates of the partial derivatives for equation (1). The signs were consistent with expectations. The coefficient for the effect of change in reserves indicates a monthly reserve multiplier of 5.2. This appears to be a reasonable measure of the speed of the bank expansion process. The positive coefficient for changes in interest rates supports the arguments of those who expect some interest elasticity in the excess reserves held by banks. The partial derivative of demand deposits with respect to time deposits as measured by the coefficient of the time deposit variable is smaller than the value of the ratio of reserve requirements (t/m). However, the ratio of reserve requirements is a theoretical limit that we cannot expect to approximate by the partial derivative based on monthly data.

The equation for the short-term interest rate shows significant and positive coefficients for the exogenous demand variables represented by changes in bank loans and in stock market activity. It shows a strong positive relationship between the interest rate and the velocity of circulation and supports the expected short-run inverse relationship between changes in the money supply and interest rates. It also gives an interesting insight into the relationship between changes in bank time accounts and the short-term interest rate. The problem of measuring the impact of changes in time deposits on the interest rate is complicated by the fact that the short-term interest rate is important as an independent variable in determining changes in time deposits (see structural equation 6). Since the movement of funds into and out of bank time deposits depends upon the spread between external market rates and the bank time deposit rate, the relationship between the interest rate and shifts in bank deposits can be held constant by including the spread between relevant market rates and time deposit rates as a separate variable. When this adjustment is made, the indicated effects of changes in time deposits on the short-term market rate becomes significant and positive. This is reassuring to those who are puzzled by statistical results that suggest that the competition for funds in the savings markets can lead to lower interest rates [14].

Evidence on the Type of Substitution Effect

The evidence from the model and related tests suggest that the second type of substitution effect, i.e. between nonbank and bank savings, was dominant during the period covered by the model, 1950-1970. The partial derivative of velocity with respect to time accounts as estimated in structural equation (5) was negative. This is strong evidence of the importance of the second type of effect. It suggests that the first term in equation (12) can be negative and therefore that the partial derivative of income with respect to time deposits can be negative. This suggests that at least during part of the period covered by the tests that the second type of substitution effect was dominant. The calculation of the equations for subperiods indicates that the negative values occurred only in the 1960's and were significant only in the last half of the 1960's. This is consistent with other evidence about the competition between bank and nonbank outlets for savings and with Federal Reserve policy actions that made bank competition for funds more effective.

It would be inappropriate to try to use this evidence of the possible importance of the second type of substitution effect to argue that the first type of substitution has never been or never will be important. But there does seem to be adequate evidence from this model and from other tests to suggest that changes in the mix of bank deposits can have a much more complex impact than simple policy guidelines imply.

Implications for Monetary Policy

These results suggest that the bank credit proxy and the broad definition of the money supply cannot be accepted as reliable policy guides. A comparison of the derivatives of income with respect to demand and time accounts (calculated from equation (11)) indicates the conditions necessary for the assumption of equality between the effects of changes in the two types of deposits.

$$\partial Y/\partial T = M\partial V/\partial T - Vt/m \qquad (12) \text{ repeated}$$

$$\partial Y/\partial M = M\partial V/\partial M + V \qquad (13)$$

When the partial derivatives of velocity with respect to each type of deposit are substituted from structural equation (5), these equations become:

$$\partial Y/\partial T = -.0032M - Vt/m \qquad (14)$$

$$\partial Y/\partial M = .00105M + V \qquad (15)$$

Even with allowances for statistical errors, the comparison of equations (14) and (15) does not offer much support for guidelines for the assumed equality of the income effects of changes in all types of bank deposits.

To the extent that the monetary authorities can control the deposit mix, the recognition and correct prediction of the effects of the deposit mix gives them a broader range of policy alternatives. To the extent that they are unable to control the mix, the effectiveness of monetary policy may be seriously reduced. Many of the apparent errors in recent monetary policy can be traced to shifts in the deposit mix that apparently were not anticipated in the initial policy actions.

The potential role of changes in the deposit mix can be illustrated by treating the ratio of time to demand accounts as a parameter in equations for tracing the effects of changes in bank reserves. Equations for the derivative of income with respect to reserves can be obtained with the deposit mix as a parameter by letting "p" equal the ratio of time to demand deposits and by substituting the resultant values in the bank reserve equality, equation (1), to obtain separate equations for demand and time deposits in terms of the mix parameter.

$$R = mD + tpD \quad (16)$$

$$R = mT/p + tT \quad (17)$$

$$dD = (m + tp)^{-1}dR \quad (18)$$

$$dT = (m/p + t)^{-1}dR \quad (19)$$

By expressing income as a function of demand and time accounts,

$$Y = \quad (D,T) \quad (20)$$

the derivative of Y with respect to R can be obtained by substituting equation (18) and (19) into the derivative of equation (20).

$$dY/dR = (\partial Y/\partial D + \partial Y/\partial T)/(m + tp) \quad (21)$$

The appearance of equation (21) can be improved by setting the partial derivatives of income with respect to demand and time accounts equal to the constants "v" and "k."

$$dY/dR = (v + pk)/(m + tp) \quad (22)$$

The denominator of the right side of equation (22) shows the role of the proportion of time to demand deposits in affecting the value of the reserve multiplier. If p is zero, the equation takes the familiar textbook form. The overall effect also depends upon the values of the terms in the numerator. As long as $k > o$, the income effects of changes in reserves will be positive and the size will depend upon the relative values of p, v and the reserve requirements. If $k < o$, as may be the case if the second type of substitution effect is dominant, the sign of the derivative could be negative, i.e. an increase in bank reserves could lead to a decrease in income. This possibility represents a special case that is usually not recognized in discussions of monetary policy. The evidence of our tests suggest that it may be more important than has previously been realized.

The implication of the deposit mix for the interest rate effects of change in bank reserves is somewhat more complex. If the derivative of the interest rate with respect to a change in demand deposits is negative ($\partial r/\partial D < o$) and that for time deposits is positive ($\partial v/\partial T > o$), as our test suggest, the effects of a change in reserves clearly depends heavily on the deposit mix. By expressing the short-term interest rate (r) as a function of demand and time deposits

$$r = g(D,T) \qquad (23)$$

and by setting the partial derivative of r with respect to D equal to the constant "e" and by setting the partial derivative of r with respect to T equal to the constant "i," the differential of r can be expressed as follows:

$$dr = edD + idT \qquad (24)$$

Substituting equations (18) and (19) into equation (24) we obtain the derivative of the interest rate with respect to total reserves:

$$dr/dR = (pi + e)/(m + pt) \qquad (25)$$

Since $i > o$ and $e < o$, the implications of a change in reserves for the level of interest rates is not nearly as simple as it is often assumed. If the ratio of time to demand deposits is large, an increase in reserves can lead to an increase in interest rates. This result may help explain the positive long-run relationship that Friedman and others have found between the broad concept of the money supply and interest rates [5]. It may also help explain the increase in interest rates that has accompanied the rapid expansion of bank reserves during the 1960's.

To the extent that the monetary authorities have difficulty in controlling the deposit mix, it is instructive to examine the effects of a change in the deposit mix with reserves held constant. Derivatives of income with respect to the ratio p can be developed from equations (16) and (17) by differentiating for p while holding R constant and by substituting the results into equations(22) and (24) to obtain:

$$dY/dp = R(km - vt)/(m + tp)^2 \qquad (26)$$

$$dr/dp = R(im - et)/(m + tp)^2 \qquad (27)$$

If the second type of substitution effect is dominant as our tests suggest ($k < o$ and $i > o$), an increase in the proportion of time deposits to total deposits will have a depressing effect on income while its effect on the interest rate will be positive. This set of possibilities is one that does not seem to have received much recognition.

The reverse case is equally interesting where a decrease in the proportion of time to demand deposits can have a stimulating effect on income and exert pressure for lower rates. To the extent that the deposit mix can be controlled, a reduction in the ratio of time to demand deposits could be used to provide a stimulus to income while exerting pressure for lower rates. This potentially attractive combination of effects for the economy as a whole would, however, imply a contraction of banking institutions relative to nonbank savings alternatives.

Summary and Conclusions

Both the empirical evidence and the theoretical arguments of this paper stress the importance of the deposit mix in shaping the impact of monetary policy. A major improvement in the effectiveness and accuracy of monetary policy might be expected to follow from the better understanding and control of the complications arising from the different types of substitution effects. There are basically two approaches to the problem of improving monetary policy to take these effects into consideration.

The first involves working within the current structure of reserve requirements to improve the prediction and control of various types of policy actions. This approach would require some extension and improvement of the techniques for controlling the deposit mix.

The second type of approach would involve a modification of reserve requirements to sever the interactions between demand and time accounts that arises from their ties to a common reserve pool. If the reserve requirements on time deposits were reduced to zero (or could be satisfied by some other type of requirement), the limits to the potential expansion of bank credit expansion from a given change in reserves could be estimated more accurately. Shifts of funds into and out of bank time accounts would not force changes in demand accounts. Of course, the gain in the ability to predict and control the demand account component of the banking system would be offset by a reduction in the ability to control the savings deposit component and the total size of the banking system through bank reserves. But by separating the problem of control, the complications arising from the interaction in the joint reserve base could be avoided and both control problems could be approached more directly. Commercial banks with no reserve requirements on savings accounts would have an additional competitive advantage over nonbank savings institutions but the control of bank savings growth and the equalization of their competitive positions could be accomplished in a number of ways.

TABLE I

Structural Equations*

(1) $\Delta Y = \Delta V\, M_{-1} + \Delta M\, V_{-1} + \Delta V\, \Delta M$

(2) $\Delta M = \Delta D + \Delta C$

(3) $$\Delta D = .83 + \underset{(26.6)}{5.2069\Delta R} - \underset{(-1.3)}{.0969\Delta T} + \underset{(1.3)}{.0826\Delta r} \qquad R^2 = .8038$$

(4) $$\Delta C = -2.42 + \underset{(8.9)}{1.314V_{-1}} - \underset{(-19.3)}{7.4432S_1} - \underset{(-6.8)}{2.6017S_2} + \underset{(1.4)}{.5482S_3} + \underset{(.6)}{.2376S_5}$$

$$+ \underset{(-1.6)}{1.01S1S_6} + \underset{(4.5)}{1.7363S_7} - \underset{(-1.6)}{.6207S_8} - \underset{(-1.2)}{.4725S_9} + \underset{(.7)}{.2566S_{10}}$$

$$+ \underset{(5.5)}{2.1168S_{11}} + \underset{(7.3)}{2.792S_{12}} \qquad R^2 = .8276$$

(5) $$\Delta V = .21 + \underset{(1.2)}{.000285\Delta L} + \underset{(5.1)}{.000138ST} - \underset{(-8.9)}{.5830V_{-1}} - \underset{(-2.3)}{.00323\Delta T}$$

$$+ \underset{(2.4)}{.00105\Delta M} + \underset{(7.5)}{.00362s} + \underset{(8.7)}{.1779S_{12}} - \underset{(-9.2)}{.2455S_1} \qquad R^2 = .8263$$

(6) $$\Delta T = 21.29 - \underset{(.9)}{.0314\Delta D} + \underset{(4.4)}{.1629q} - \underset{(-8.4)}{.0630r} - \underset{(-1.9)}{.1064s} + \underset{(6.1)}{5.0850S_{12}} \qquad R^2 = .3891$$

(7) $$r = -268.49 + \underset{(6.2)}{.5341\Delta L} + \underset{(4.3)}{.0515ST} + \underset{(22.1)}{180.1932V_{-1}} + 2.9917\Delta T$$

$$- \underset{(-4.4)}{.3495\Delta M} + \underset{(23.8)}{1.0730(r-q)_{-1}} \qquad R^2 = .9686$$

*Estimated by the method of two stage least squares. "t" values appear in the parentheses.

Reduced Form Equations

(1) $$\Delta D - 5.96 + \underset{(21.6)}{4.9079\Delta R} + \underset{(1.8)}{.0429\Delta L} + \underset{(.8)}{.0028ST} + \underset{(2.9)}{15.9910V_{-1}}$$

$$- \underset{(-.1)}{.0011M_{-1}} - \underset{(-.5)}{.0194q} + \underset{(.2)}{.0015r_{-1}} - \underset{(-1.5)}{.0877s} + \underset{(.8)}{1.5936S_{12}}$$

$$- \underset{(-.2)}{.3957S_1} \qquad R^2 = .8159$$

TABLE I (Continued)

Reduced Form Equations

(2) $$\Delta T = 49.3 + \underset{(1.4)}{.3301\Delta R} - \underset{(-1.6)}{.0141\Delta L} + \underset{(.5)}{.0016ST} - \underset{(-4.0)}{21.5910V_{-1}}$$

$$- \underset{(-1.3)}{.0115M_{-1}} + \underset{(4.7)}{.1960q} - \underset{(-5.2)}{.0431r_{-1}} - \underset{(-.3)}{.0196s} - \underset{(-1.9)}{3.5077S_{12}}$$

$$+ \underset{(4.6)}{10.1047S_1} \qquad R^2 = .4264$$

(3) $$\Delta V = .5702 + \underset{(3.1)}{.006515\Delta R} + \underset{(1.3)}{.000278\Delta L} + \underset{(2.9)}{.000094ST} - \underset{(-11.6)}{.5861V}$$

$$- \underset{(-.8)}{.000063M_{-1}} + \underset{(1.8)}{.000713q} + \underset{(3.6)}{.000288r_{-1}} + \underset{(4.0)}{.00216s} + \underset{(10.5)}{.1860S_{12}}$$

$$- \underset{(-13.2)}{.2661S_1} \qquad R^2 = .8348$$

(4) $$r = -23.56 + \underset{(.4)}{.2569\Delta R} + \underset{(1.0)}{.0291\Delta L} + \underset{(.9)}{.0057ST} - \underset{(-2.2)}{.0871V_{-1}}$$

$$- \underset{(-1.7)}{.0367M_{-1}} + \underset{(.6)}{.0719q} - \underset{(-37.9)}{.9121r_{-1}} - \underset{(-2.1)}{.3545s} + \underset{(2.4)}{13.4401S_{12}}$$

$$- \underset{(-3.0)}{18.56S_1} \qquad R^2 = .9849$$

Endogenous Variables

ΔD = change in demand deposits, all commercial banks

ΔC = change in currency in circulation

$\Delta M = \Delta D + \Delta C$

ΔT = changes in time deposits, all commercial banks

r = rates on 3 to 6 month U.S. Treas. bills

Exogenous Variables

ΔR = changes in the total reserves of member banks (adjusted for changes in reserve requirements)

ΔL = changes in total bank loans, all commercial banks

ST = dollar volume of trading on the N.Y. Stock Exchange

TABLE I (Continued)

q = average rate paid on time and savings accounts at commercial banks

s = average rate paid on savings accounts at savings and loan associations and mutual savings banks

S_i = seasonal dummy for the i^{th} month (monthly data not adjusted for seasonal variations)

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