3. Monetary Base Control III

Recent Monetary Policy Strategies in the United States

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the new strategy, these changes have not been sufficient to achieve its monetary targets. In the Spring of 1980 the money supply (M1B) dropped rapidly for several months, despite a targeted growth rate of 5 per cent and remained well below the levels implied by the announced growth target ranges of 4 to 6 1/2 per cent well into the Summer. Effectively the Fed operated with a funds rate strategy during that period as reserve targets were abandoned in order to stay above the lower funds rate constraint and the FOMC was unwilling to adjust the funds rate range sufficiently to stay within the money supply range.

Implicitly the FOMC was lowering its target for money. While one might have some sympathy for the FOMC's fear that rapidly falling interest rates would worsen inflationary expectations and create an interest differential with other countries that would depreciate the dollar as hot money moved abroad, it would be hard to convince Detroit that the exchange rate shouldn't fall nor the newly unemployed that the sharp drop in output over the same period justifies a falling money supply. It may also be that the old reluctance to adjust any of the policy parameters very rapidly has added to the inflexibility of the funds rate range.

If the Fed is to stick with their monetary targets—and there is considerable empirical evidence that suggests they should—it would be better to tie the funds rate range to the current Treasury bill rate (perhaps a 3 or 5-day moving average of the most recent rates). Better yet would be a complete break with the Fed's interest rate tradition by dropping the rate ranges from the directive altogether, leaving it to the banking industry to adapt its ways to volatile one-day rates while the Fed focuses its energies on improving reserve supply and demand estimates.

V. Conclusion

While there are some advantages to stable interest rates, just as there are for stable exchange rates and price levels, such stability is rarely achieved for long by policies designed to fix them directly. Pegging interest rates or exchange rates or administratively fixing or managing prices has ultimately diminished rather than enhanced the desired stability by reducing the pressures to maintain a stable monetary policy. The volatile monetary behavior resulting from efforts to stabilize interest rates in an ever-changing world has led to interest rate volatility inconceivable with steady monetary growth. Whatever its faults, the new operating strategy promises greatly enhanced control of the money supply if the interest rate constraint does not rigidify into the old funds rate strategy.

Analytical Appendix

In principle a general equilibrium model of the economy can be solved for the Federal funds rate (leaving reserves to be endogenously determined) in terms of the desired values of the goal variables (or in a two-stage process, in terms of the money supply target), or it can be solved for reserves (leaving the funds rate to be endogenously determined) in terms of the same variables. Solving such a model for the Federal funds rate in terms of the money supply provides the relationship between these two variables underlying the Fed funds strategy. Inserting the targeted value of the money stock into such a reduced form yields the Federal funds rate target. A similar approach yields the reserve target.

However, there are some important differences between principle and practice. No widely accepted general equilibrium model of the money supply is currently in use. Two less general approaches have characterized modeling of the money supply process. One takes the "supply" of money as given exclusively by the public's demand for it and the other focuses attention on the supply and demand for bank reserves. Of the two, the multiplier approach has the better claim as a theory of the money supply. Taking currency as given and focusing attention on the banking sector's deposits, the multiplier approach is usually built upon banking sector reserve equilibrium. As such it is a partial equilibrium approach. Deposit supply is taken as the level of deposits which clears the reserve market, i.e., which equates the supply and demand for reserves. Solving this equilibrium relationship for deposits in terms of reserves (or for money in terms of the monetary base) yields the traditional multiplier. The two approaches yield the same result if the deposit market clears instantaneously (i.e. if $D^d = D^s$ at all times). As will be seen the two approaches are not interchangeable if there are adjustment costs.

The distinction between these approaches is analyzed in terms of a model used by Richard Davis 1/ as the basis for choosing between a Federal funds rate strategy and a reserve strategy. The approach is the same as William Poole's for analyzing the choice between an interest rate and a monetary aggregate as intermediate targets. 2/ Equations (1) to (2) reproduce Davis' deposit demand (D^d) and supply (D^s) equations with signs adjusted so that all coefficients are positive. 3/

(1) $D^d = b_1Y - b_2i + u$ (Demand)

(2) $D^s = c_1Ru + c_2i + e$ (Supply)

where Y is nominal income and i is the interest rate. In place of reserves he uses nonborrowed reserves (Ru). By defining Ru as nonborrowed reserves supplied directly by the Fed, e represents changes in borrowed reserves, non-Federal Reserve impacts on total reserves (i.e., market factors) and stochastic shifts in desired excess reserves. 4/ Davis' assumption that the interest rate adjusts instantaneously so as to continuously clear the deposit market means that with

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1/ Richard G. Davis, "Implementing Open Market Policy with Monetary Aggregate Objectives," in Monetary Aggregates and Monetary Policy, Federal Reserve Bank of of New York, October 1974.

2/ William Poole, "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model," Quarterly Journal of Economics, May 1970.

3/ Davis, op. cit., p. 14.

4/ Davis' deposit supply equation can be obtained by equating the supply and demand for reserves,

(a) $R^d = (r + a_1)D - a_2i + \varepsilon_E$

(b) $R^s = Ru + Rb + \varepsilon_F$

where r is the reserve requirement ratio, a_1 is $\partial ER/\partial D$; a_2 is $|\partial ER/\partial i|$; Ru is the quantity of nonborrowed reserves supplied by the Fed, Rb is borrowed reserves and ε_F is the quantity of reserves supplied by "market factors." Equating and solving for deposits gives Davis' equation (2) where $c_1 \equiv 1/(r+a_1)$, $c_2 \equiv a_2c_1$, and $e \equiv (Rb + \varepsilon_F - \varepsilon_E)c_1$.

an interest rate target the behavior of deposits is given by the following reduced form equation:

(3) $D^s = b_1Y - b_2i^* + u = D^* + u,$

"where i* is the weekly interest rate target used by the Federal Reserve," 1/ and D* is the deterministic value of D given Y and i*. This is the basis for treating deposit <u>supply</u> as <u>demand</u> determined as the reduced form equation (3) is identical to the demand equation (1). Davis contrasts the behavior of deposits in (3) with that obtained with a reserve target as seen in his reduced form equation (4):

$$(4)\quad D^s = \frac{b_1c_2}{c_2+b_2}Y + \frac{b_2c_1}{c_2+b_2}Ru^* + \frac{c_2}{c_2+b_2}u + \frac{b_2}{c_2+b_2}e = D^* + \frac{c_2u + b_2e}{c_2 + b_2}.$$

Applying Poole's criteria, if nominal income is known with certainty, deposit control is greater with a Fed funds rate target if $\sigma_u < \frac{b_2}{b_2 + 2c_2} \sigma_e$ where σ_u is the variance of u, i.e. $\sigma_u \equiv E[u^2]$ etc. 2/ It should be recalled that e contains the impact on reserve availability of "market factors" which the Fed has always maintained are rather difficult to forecast. The funds rate strategy had the virtue of automatically injecting or draining reserves sufficient to just offset the reserve effect of market factors.

1/ Davis, <u>op. cit.</u>, p. 14. The solution is obtained by solving the system for Ru in terms of i etc (i.e. by equating equations (1) and (2) and solving), then substituting the expression for Ru thereby obtained into equation (2).

2/ It is assumed throughout that all stochastic terms have zero means and variances of σ_x, and that all covariances, σ_{xy}, are zero. The superior strategy is taken by Poole to be the one which minimizes a quadratic loss function. In this case the superior strategy is the one which minimizes: $C = E[(D - D^*)^2]$.

There are several serious shortcomings with this partial equilibrium framework. The first derives from the assumption of instantaneous and continuous clearing of the deposit market and the second from its partial equilibrium nature. Equations (3) and (4) treat observed deposits as always being equal to their demand. In fact, many economists argue that the quantity of deposits can be altered only by altering the public's demand for them. Hence a change in the Federal funds rate operates on deposit supply through demand. 1/ While the simplification afforded by the assumption of instantaneously clearing financial markets has yielded high dividends for many purposes, it can be seriously misleading in judging the efficacy of the funds rate strategy for implementing monetary policy. As pointed out by Niehans, "the perfect liquidity of cash balances is no compelling reason to expect a high adjustment speed, since the latter refers to a shift from money into other assets or consumption and thus the characteristics of those other assets assets are also relevant. In fact, it may well be that cash balances, being a typical 'buffer stock' asset, are characterized by quite low adjustment speeds." 2/

This possibility can be modeled by replacing the implicit equation $D^d = D^s = D$ by the partial adjustment equation

(0) $\Delta D^d = \lambda(D^s - D^d)$. 3/

1/ Even with the new reserve strategy the New York Federal Reserve Bank continues to forecast the longer-run behavior of the money supply by plugging funds rate and income forecasts into a money demand equation.

2/ Jürg Niehans, The Theory of Money, (Baltimore: Johns Hopkins University Press, 1978), p. 241.

3/ Dennis R. Starleaf, "The Specification of Money Demand-Supply Models Which Involve the Use of Distributed Lags," Journal of Finance, September 1970, pp. 743-760.

The use of a discrete time formulation emphasizes the assumption that in the short run the public can be off its "long-run demand curve" because it finds it optimal to adjust gradually to independent changes in deposits. Observed deposits are those given by the banking sector's behavior contained in equation (2), rather than the public's demand in equation (1). Reserve market adjustment which underlies equation (2) is instantaneous (i.e., quicker than money (deposit) market adjustment as depicted in equation (0)).

This formulation and the notion of an independent (from demand) deposit supply is rejected by many economists on the grounds that the deposit rate restrictions in Regulation Q prevent banks from operating on their true deposit supply functions. While this might be true (if interest regulations are effective) it does not follow that observed deposits are always on the public's demand schedule. A binding Regulation Q will constrain, i.e. modify the banking sector's reserve demand and credit supply, but as long as banks succeed in these (albeit modified) portfolio desires they also succeed in achieving the implied (albeit modified) supply of deposits. 1/2/ The model developed here

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1/ The verbal argument presented here assumes a simple banking sector balance sheet containing two assets (reserves and credit) and one liability (deposits) so that deposit supply is implicitly given by the balance sheet as a reflection of reserve demand and credit supply. The notion of deposit supply is developed more formally subsequently (see equation (5)). For a more elaborate model and a more extensive discussion of this issue see the author's "The Implications of Distinguishing Money and Credit for Implementing the Federal Reserve's Monetary Directives," and "Modeling the Short-Run Demand for Money with Exogenous Supply."

2/ The intuitive appeal of treating changes in deposits as a demand side phenomenon is strongest among those who picture deposit creation as resulting from customers walking in off the street to convert currency notes into deposits. Intuition is reversed (i.e. deposit changes are viewed as a supply side phenomenon) among those who picture deposit creation as resulting from banks extending credit by marking up their deposit liabilities. Of course both phenomena interact. Given their reserves, banks' portfolio behavior does impose or create a well-defined quantity of deposits, while the public's currency-deposit behavior (given the monetary base) determines banks' reserves.

also assumes perfect arbitrage between financial assets (other than deposits) making it possible to use a single rate of interest.

Solving the modified equations (0)-(2) for deposits as a function of interest rates gives:

$$(3') \quad D = -\frac{b_2}{\lambda}\Delta i^* - b_2 i_{-1} + \frac{b_1}{\lambda}\Delta Y + b_1 Y_{-1} + \frac{\Delta u}{\lambda} + u_{-1} = D^* + \frac{u,(1-\lambda)u_{-1}}{\lambda} ,$$

which for $\lambda = 1$ reduces to equation (3). Equation (4) becomes:

$$(4') \quad D = \frac{c_1 b_2}{z} Ru + \frac{c_2 b_1}{z}\Delta Y + \frac{\lambda c_2 b_1}{z} Y_{-1} + \frac{(1-\lambda) b_2 c_2}{z} i_{-1}$$

$$+ \frac{b_2}{z} e + \frac{c_2}{z}\Delta u + \frac{\lambda c_2}{z} u_{-1} = D^* + \frac{b_2}{z} e + \frac{c_2 u - (1-\lambda) c_2 u_{-1}}{z} ,$$

where $z \equiv \lambda c_2 + b_2$. Assuming as before that Y is constant (or independent and predictable with certainty) and that all lagged values are known, the condition for deposits to be more stable under a funds rate target becomes:

$$\sigma_u < \frac{\lambda b_2}{b_2/\lambda + 2c_2}\sigma_e .$$

λ reduces the numerator and increases the denominator, therefore

$$\frac{\lambda b_2}{b_2/\lambda + 2c_2} < \frac{b_2}{b_2 + 2c_2}$$

as long as $\lambda < 1$. The effect of the adjustment lag λ in the deposit market is to tilt the choice of operating strategies away from the funds rate. It can also easily be shown by solving the system for i in terms of Ru, that the funds rate becomes less volatile with a reserve target as λ falls below 1. 1/

1/ See the author's "Monetary Aggregate Targets and the Volatility of Interest Rates: An Addition," mimeograph.

This is by no means the only nor probably the most serious shortcoming of Davis' framework for evaluating the choice of operating strategies. In a general equilibrium setting it is clear that changes in reserves also affect nominal income and hence the demand for deposits. In the medium run, changes in reserves and hence deposit supply may change nominal income by changing real income and/or prices, while in the long run the effect is predominantly through the price level. Thus changes in reserves systematically affect the demand for deposits and hence the relationship between deposits and the rate of interest. As can be seen in equation (3), with a given Federal funds rate, deposits will vary by more than the random term u when changes in nominal income are taken into account. Obviously, any change in Y as a result of a change in money or reserves within the same week are negligible. However, between this very short run and the long run, full adjustment takes place and must be accounted for somewhere. In short, while induced changes in Y will not significantly affect the choice of a Fed funds rate or reserve operating target, they will have a great deal to do with the appropriate rate to peg within each week. That rate will change each week as the lagged adjustment in Y takes place.

Changes in inflationary expectations, and hence the relationship between real and nominal interest rates, are an important additional source of uncertainty in the relationship between deposits and the funds rate. Endogenizing Y and inflationary expectations by combining the monetary with the real sectors further tilts the choice of operating strategies away from interest rates. In fact, as is well known, an interest rate target is unstable (yields an explosive deposit level) when adjustments are instantaneous.

The shortcomings of relying on a partial equilibrium framework are apparent when attempting to analyze the policy implications of lagged reserve accounting. The propensity for deposit multiplier analysis to focus on reserve market equilibrium tends to obscure the actual mechanism and linkages by which the Federal Reserve influences deposit behavior. This is particularly apparent in earlier efforts to model deposit consequences of lagged reserve accounting. 1/ Modifying the reserve market equations (a) and (b) (given earlier in a footnote) to reflect lagged reserve accounting, adding a borrowed reserves equation, and distinguishing three interest rates (i, the loan rate; i_f, the Fed funds rate; and i_d, the discount rate) in anticipation of subsequent discussion of the discount window, yields the following reserve market equilibrium conditions:

(a') $R^d = rD_{-2} + a_1 D - a_2 i - a_3 i_f + \varepsilon_E$

(b) $R^s = Ru + Rb + \varepsilon_F$

(c) $Rb = g_o + g_1 (i_f - i_d) + \varepsilon_G$

(d) $R^d = R^s$

Therefore,

$$(2') \quad D^s = \frac{g_o - rD_{-2}}{a_1} + \frac{a_2}{a_1} i + \frac{a_3 + g_1}{a_1} i_f - \frac{g_1}{a_1} i_d + \frac{Ru}{a_1} + \frac{\varepsilon_F + \varepsilon_G - \varepsilon_E}{a_1} .$$

In equation (2') the determinacy of deposits seems to hang on the tenuous existence of a deposit-related level of desired excess reserves. However, it is commonly believed that the value of a_1 for the U.S. banking system is approximately zero, in which case deposits in equation (2') are indeterminate. What

1/ See, for example, John P. Judd, "The Quantitative Impact of Lagged Reserve Requirements on Monetary Control," mimeograph, undated, Federal Reserve Bank of San Francisco; and the author's "The September 1968 Changes in 'Regulation D' and Their Implications for Money Supply Control," unpublished Ph.D. thesis, University of Chicago, 1972.

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reserve market equilibrium yields instead is a relationship between unborrowed reserves and interest rates.

The apparent instability results from incorrectly treating equation (2') as the deposit supply function. In the real world lagged reserve accounting has not made week-to-week deposit movements unstable, as implied by equation (2') (though there have been some very irratic weekly changes). The banking sector's supply of deposits depends not only on reserve market conditions, but on bank willingness to extend loans (and on all other items in bank balance sheets). For the simplest possible balance sheet assumptions, the banking sector's supply of deposits equals its supply of credit plus demand for non-borrowed reserves, i.e.,

$$D^s + Rb \equiv L + Ru' + Rb, \text{ or}$$

(e) $D^s \equiv L + Ru'$,

where L is bank loan supply, and $Ru' \equiv Ru + \varepsilon_F \equiv R - Rb$. Specifying loan supply as a reserve-adjusted function of loan rates and the banks' cost of funds (taken here as given by the Fed funds rate),

(f) $L = l_o + l_1(1 - r)i - l_2 i_f + \varepsilon_L$,

and making all of the indicated substitutions and using equation (2') (solved for the Federal funds rate) to eliminate the endogenous funds rate, yields the deposit supply function:

(5) $D^s = h_o - h_1 i_d + h_2 i + h_3 Ru + h$, where

$$h_o = \frac{l_o + x(g_o - rD_{-2})}{1 + xa_1}, \quad h_1 = \frac{xg_1}{1 + xa_1}, \quad h_2 = \frac{l_1(1 - r) + xa_2}{1 + xa_1},$$

$$h_3 = \frac{1 + x}{1 + xa_1}, \quad h = \frac{\varepsilon_L - \varepsilon_E + x(\varepsilon_F + \varepsilon_G)}{1 + xa_1} \quad \text{and} \quad x = \frac{l_2}{a_3 + g_1}.$$

In equation (5) (unlike equation (2')) deposits are perfectly determinate and stably related to unborrowed reserves, even when $a_1 = 0$. Combining equations (1) and (5) (with either $D^s = D^d$ or with equation (0)) allows a solution for the loan rate (i) in terms of policy parameters i_d and Ru. Substituting the resulting expression for i into equation (5) gives the (predicted) level of deposits as a function of the same two policy parameters. Federal Reserve modeling of the money supply process tends to focus on equations (1) and (2) rather than equation (5).

The role of the discount window is somewhat submerged in equation (5). Given the loan rate (i), the deposit supply depicted there can be thought of as a function of the cost of funds (i.e. the funds rate) where this is determined by the two policy instruments i_d and Ru. The model presented here uses the Fed's interpretation of the operation of the discount window which is seen more clearly by solving equation (c) for the funds rate which gives the rate as an increasing function of the discount rate and the extent to which banks are "forced" to borrow,

$$\text{(c')} \quad i_f = i_d - g_o/g_1 + Rb/g_1 - \varepsilon_G/g_1 \, .$$

Changes in the discount rate affect the Fed funds rate directly while changing nonborrowed reserves does so indirectly (by changing borrowed reserves given reserve demand).

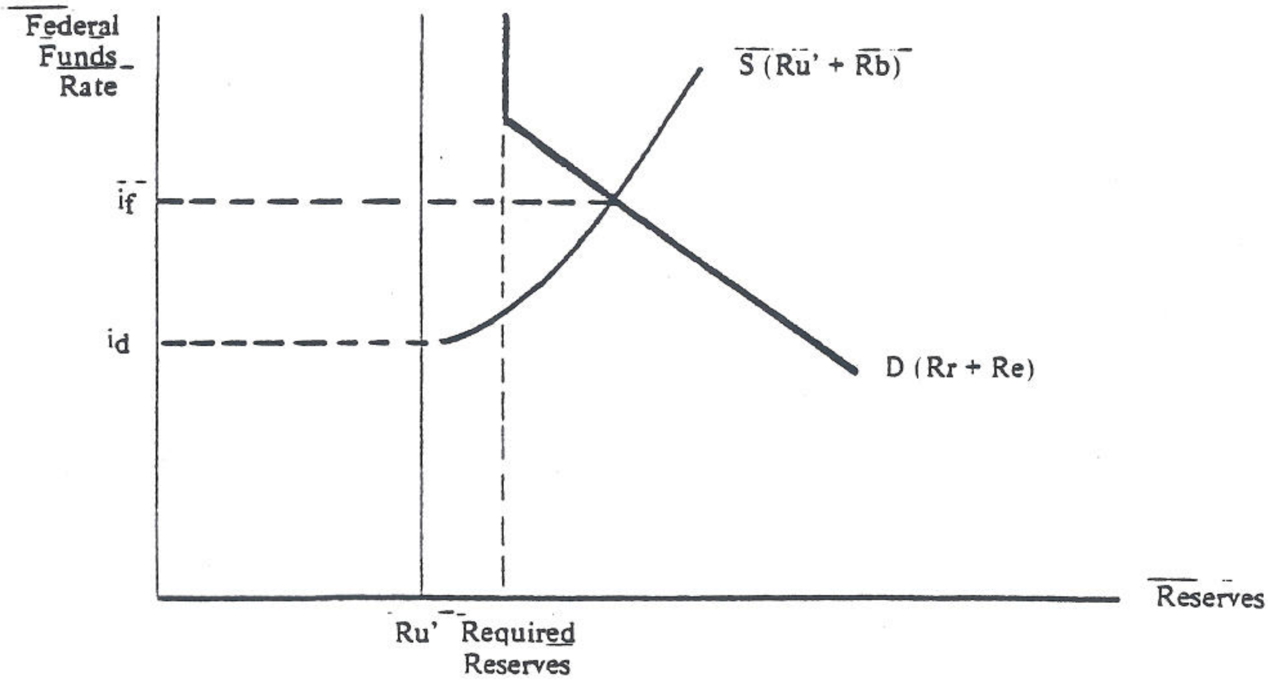
Formally speaking, the model developed here treats borrowed reserves as perfect substitutes for reserves obtained in the Federal funds market, where the cost of borrowed reserves is the discount rate plus the nonpecuniary costs imposed by the Fed's administration of the window. The demand for borrowed reserves is, therefore, implicit in equation (a') and is obtained by subtracting an exogenously given level of nonborrowed reserves from each side. Equation (c), or more appropriately equation (c'), is a supply function, not a demand function. It establishes the terms on which the Fed will supply reserves through the discount window. The more banks borrow, the higher the price set by the Fed. This price (the discount rate plus nonpecuniary costs) is always measured by the Federal funds rate.

The following diagrams reflect the above assumptions about the behavior of the discount window and help clarify the workings of the new strategy in the presence of lagged reserve accounting, which makes control of the current week's total reserves impossible.

Figure 1 presents the supply (S) and demand (D) for total reserves (i.e. equations (a') through (d)). The supply of reserves schedule is the sum of nonborrowed and borrowed reserves. Beyond the "normal" level of borrowed reserves additional borrowing initiates tighter administration of the discount window, hence an increasing spread between the discount rate and the funds rate, so that the supply of total reserves at a particular funds rate depends on the quantity of nonborrowed reserves. The demand for reserves schedule is the sum of required reserves and desired exess reserves. Because of lagged reserve accounting, required reserves are a predetermined constant within the week, while desired excess reserves will depend on the expected yields on bank loans and investments, the price level, income, etc. as well as the cost of purchased reserves, i.e., the Federal funds rate (see equation (a')). All factors other than the Federal funds rate, especially other interest rates, are held constant

FIGURE 1

Reserve Market



in this discussion so that the vertical axis reflects varying interest differentials between the cost and use of reserves. Any difference between the discount rate and the Federal funds rate is taken as the market's revealed nonprice cost of borrowing from the discount window (i.e., the intensity of window administration) so that at the margin the full cost of these two sources of reserves are always the same.

The intersection of the supply and demand for reserves curves depicted in Figure 1 determines the funds rate and total reserves, given the values of the other variables in equation (2'). Obtaining the supply of deposits (given the loan rate) requires combining this result with the banking sector's balance sheet constraint and loan supply functions as depicted in Figure 2. Starting with the desired (targeted) level of deposits, one can determine the intersection of the reserve supply and demand schedules consistent with that target. 1/ This desired intersection is expressed as a target level of reserves (or unborrowed reserves) in a reserve strategy or as a target funds rate for a money market strategy. Differences between the two strategies emerge when the relationships are not perfectly known. In Figure 2 the reserve demand and loan supply curves shift in response to changes in the loan rate, income, prices, lagged deposits, etc. while the reserve supply curve shifts in response to changes in nonborrowed reserves (including "market factors") and the discount rate.

Figure 3 depicts the differences between interest rate and reserve targeting when the actual reserve demand function is D' while policy targets assumed

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1/ Bearing in mind the important qualification that the result depends, among other things, on the assumed loan rate.

FIGURE 2

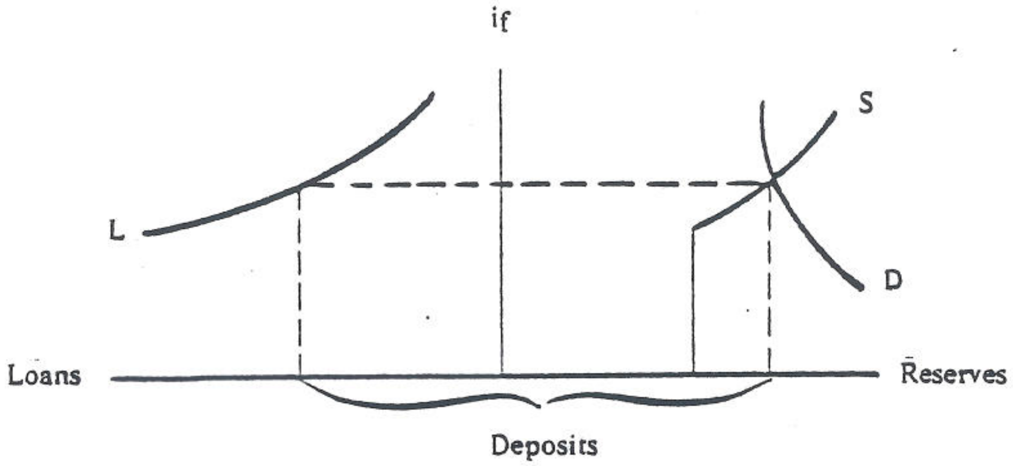
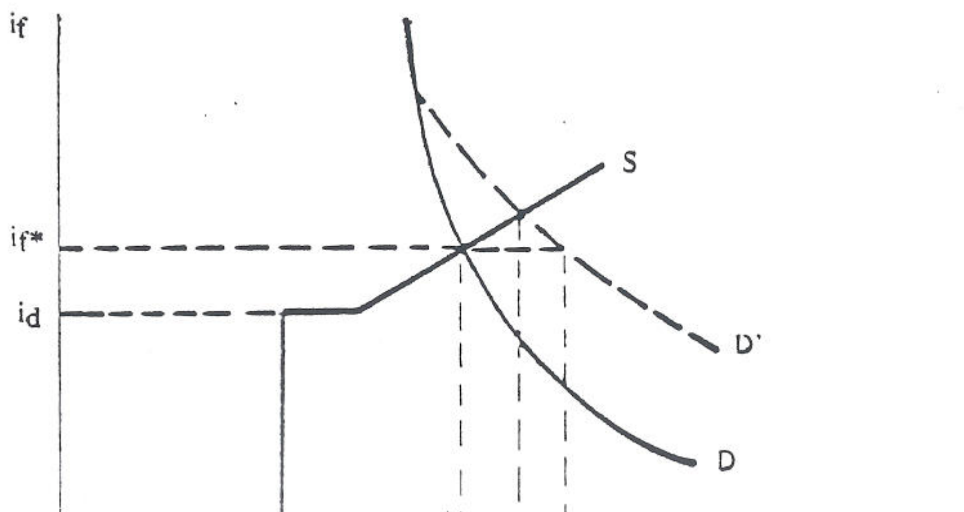


FIGURE 3



it to be D. Holding nonborrowed reserves constant leads to an increase in the funds rate and some increase in total reserves (R_1). A money market strategy, on the other hand, holds the funds rate at i_f* while injecting a larger quantity of reserves (R_2). Which of these two approaches is most disruptive to deposits depends on the source of shift in reserve demand and cannot be determined from the partial equilibrium framework depicted here.

On the other hand, disturbances to the supply of nonborrowed reserves (Figure 4), which are totally neutralized by a funds rate target, are partially offset by a nonborrowed reserve target due to the cushioning effect of discount window borrowing.

A proper evaluation of deposit behavior with a funds rate or reserve target requires the more general framework of financial sector behavior outlined earlier, which includes the specification of a proper deposit supply function (such as equation (5) in the case of a nonborrowed reserve target) rather than the incomplete framework of equation (2). Combining equation (5) with equation (1) (i.e., letting $D^s = D^d$) in order to solve out the loan rate gives (equilibrium) deposits as a function of the discount rate, nonborrowed reserves and exogenous (e.g. income and lagged deposits) and stochastic factors.

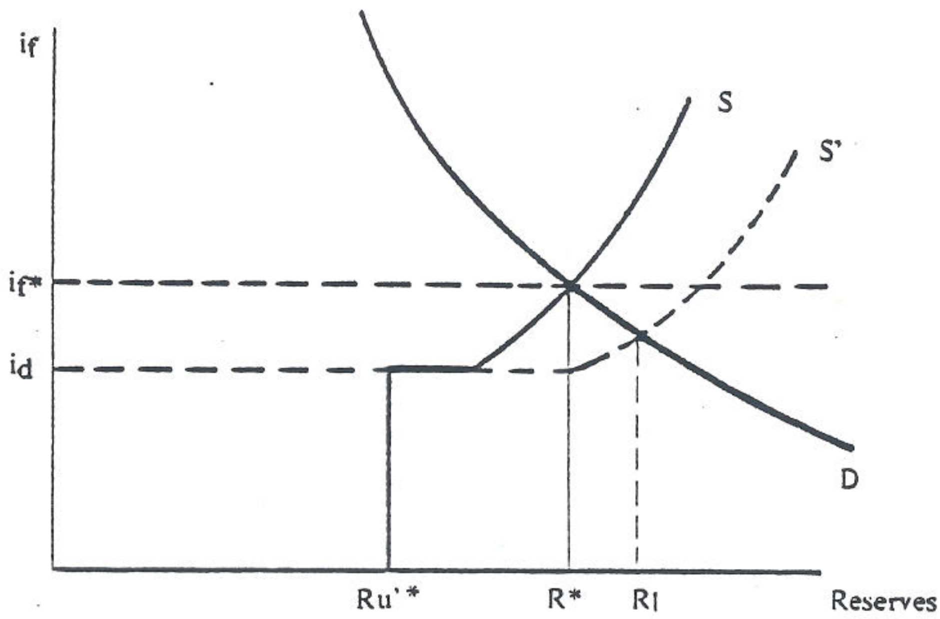
$$(4'') \quad D = wh_o - wh_1 i_d + [(wb_1 h_2)/b_2]Y + wh_3 Ru + w[(h_2 u)/b_2 + h],$$

where $w = b_2/(b_2+h_2)$. For a funds rate target the comparable expression is:

$$(3'') \quad D = \frac{l_o - g_o + rD_{-2}}{v} - \frac{a_s + g_1 + l_2}{v} i_f + \frac{g_1}{v} i_d + \frac{[l_1(1-r) - a_2]b_1}{vb_2} Y + \frac{l_1(1-r) - a_2}{vb_2} u + \frac{\varepsilon_E - \varepsilon_L - \varepsilon_F - \varepsilon_G}{v},$$

where $v = 1 - a_1 + \dfrac{l_1(1-r) - a_2}{b_2}$.

FIGURE 4



The consequences for deposits of various disturbances and policy shifts (such as the disturbances depicted in Figures 3 and 4) can be determined by an examination of these two equations, assuming no change in income, prices or inflationary expectations.

Improving monetary control is dependent on improving our models of the process determining bank deposit behavior. The practice of forecasting the money supply from money demand functions has been an impedement to improving short run monetary control and the construction of a more successful operating strategy. In my judgment the further development in the direction suggested here is more promising.