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SHORT-RUN MONETARY CONTROL

UNDER ALTERNATIVE RESERVE ACCOUNTING RULES

by

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Short-Run Monetary Control Under Alternative Reserve Accounting Rules

John P. Judd and John L. Scadding*

On October 6, 1979, the Federal Reserve announced that it would place "a greater emphasis in day-to-day operations on the supply of bank reserves and less emphasis on confining short-term fluctuations in the Federal-funds rate." This announcement signaled a fundamental change in the way the Federal Reserve attempts to achieve its publicly announced target ranges for the monetary aggregates.[1] Specifically, the current monetary-control method rests on targeting the *quantity* of bank reserves directly, whereas the previous method involved targeting the *cost* faced by banks to obtain those reserves, the Federal-funds rate. The new emphasis on the quantity of bank reserves has made the choice of reserve accounting rules—i.e., the rules which define the quantity of reserves the Federal Reserve *requires* banks to hold—an important monetary-control issue.

This paper is designed to analyze the short-run monetary-control properties of several alternative reserve-requirement rules under the new reserves-control procedures. The analysis is conducted in terms of a short-run money-supply model recently developed at the Federal Reserve Bank of San Francisco.[2] The model emphasizes the role of the Federal-funds market—the market in which banks borrow reserves from other banks and nonbank lenders—in determining the supply of money.

Commercial banks presently operate under so-called lagged-reserve accounting.[3] Under this rule, the Federal Reserve requires that, in any given week, banks hold reserves equal to certain fixed proportions of their liabilities outstanding *two weeks ago*. Thus required reserves are predetermined in any given week, and as a consequence, banks have no way to avoid deficiencies if the Federal Reserve does not supply at least enough total reserves to meet the requirements. Some analysts have criticized this feature of lagged accounting as weakening monetary control, because it means that the supply of reserves must adjust to meet banks' reserve needs. Instead, they argue, this process should be reversed if monetary control is to be effective: i.e., the Federal Reserve should supply a fixed quantity of reserves, to which the banking system would have to adjust its required reserves through deposit changes.

Three alternative rules are claimed to have superior monetary-control properties to lagged reserve accounting. The most prominent of these is contemporaneous reserve accounting, the rule used prior to September 1968.[4] Under this rule, bank reserve requirements are calculated as fixed proportions of deposits in the *current* week. As a consequence, this rule allows banks to adjust their required reserves to a fixed supply by the Federal Reserve. For example, if the Federal Reserve wanted to reduce the money supply, it could supply fewer reserves than banks are required to hold at current deposit levels. Banks, with potential reserve deficiencies, would then act to reduce their deposit levels (and thus their required reserves) to the fixed supply.

While contemporaneous accounting is advantageous for monetary control, it imposes certain reserve-adjustment costs on banks.

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Specifically, banks find it costly to acquire the contemporaneous deposit information on a timely enough basis to calculate reserve requirements accurately in any given week. This problem has led to the development of two alternative proposals, which attempt to avoid the monetary-control difficulties of lagged accounting without imposing the reserve-adjustment costs of contemporaneous accounting. First, William Poole of Brown University has proposed that lagged reserve accounting be amended to include a 100-percent reserve requirement on the *change* in deposits between the current week and two weeks previously (hereafter referred to as marginal reserve accounting).[5] Second, Robert Laurent of the Federal Reserve Bank of Chicago has proposed a rule which essentially reverses the lagged accounting rule by basing requirements on contemporaneous deposits but allowing banks to use only last week's reserves to satisfy these requirements (hereafter referred to as reverse lag accounting).[6] Both rules allow banks to adjust required reserves (through current deposit changes) to a fixed supply of reserves, since both include current deposits as at least part of the reserve-requirement calculation. Both rules also ease reserve-adjustment costs for technical reasons discussed below (Section II).

This paper examines, for each of these four reserve-accounting rules, deposit-control errors resulting from two types of "shocks" to the reserves market: (1) an unexpected shift in the public's demand for money or bank credit, and (2) an unexpected shift in banks' demand for borrowed reserves from the Federal Reserve. These "shocks" represent two important sources of money-control errors—those which affect banks' demand for reserves and those which affect the supply of reserves. It is thus useful to choose a reserve accounting rule which insulates the reserve market from these "shocks."

However, tighter monetary control often causes larger fluctuations in the Federal-funds rate. Economists disagree over how large such fluctuations can become before they impose significant economic costs (e.g., disruptions of credit flows), but the Federal Reserve in effect must make that decision each month when it sets its short-run monetary-control policy. As noted earlier, the primary emphasis of current policy is on bank reserves. The Fed, however, has a secondary concern with the Federal-funds rate, as reflected in the tolerance band set for this rate each month. (But the band is rather wide—6 percentage points wide in August 1980, for example.) Thus an evaluation of alternative reserve-requirement rules within the context of current monetary-control procedures requires some attention to interest-rate variability. Our approach in this article will mirror the Federal Reserve's current approach—with primary emphasis on monetary control and secondary emphasis on interest-rate variability.

Our overall conclusion is that short-run monetary control would be improved by replacing the lagged accounting rule presently used with either marginal or contemporaneous accounting. On purely monetary-control grounds, marginal accounting makes deposits more resistant to unexpected "shocks" than contemporaneous accounting. However, marginal accounting can entail significant interest-rate variability. It also reduces the Federal Reserve's ability to prevent unwanted funds-rate changes, such as when the tolerance range for that rate is violated.

Thus when considering both interest-rate variability and monetary control, the contemporaneous rule may be an effective compromise choice. A possible alternative would be marginal accounting but with the marginal reserve-requirement ratio reduced to, say, 75 or 50 percent. This change would retain part of the rule's monetary-control advantage, and give the Federal Reserve greater control over the funds rate.

Lagged accounting and reverse lag accounting have the disadvantage that their short-run control properties depend heavily on the Discount Window. If such borrowings were near zero, lagged accounting would make for poor monetary control with reserves, while reverse

lag accounting would provide excellent control—but no better control than would be provided by contemporaneous and marginal accounting. If borrowed reserves were significantly positive, reverse lag accounting could lead to very large swings in borrowed reserves, deposits and the funds rate, depending on how accurately banks were able to forecast the following week's funds rate.

The next section of the paper describes the money-supply model. Section II then uses this model to analyze the monetary-control properties of the four reserve-accounting rules: first, with shifts in the demand for bank credit or deposits, and second, with shifts in the demand for borrowed reserves. Section III contains a summary and conclusions.

I. Short-Run Deposit Supply Model

The deposit supply model emphasizes the role of banks' management of non-deposit sources of funds in determining the supply of deposits.[7] (A formal derivation of the model is given in the Appendix.) By deposits we mean the traditional deposit components of the monetary aggregates—demand and other checkable deposits and small time and savings deposits. Non-deposit funds on the other hand represent alternatives to these traditional deposits as a way of banks raising funds (even though technically they may be deposits, like large CDs, for example.) Non-deposit sources can be divided into three broad categories: managed liabilities (such as large CDs and Eurodollar borrowings), Federal-funds transactions and repurchase agreements, and discount-window borrowings. In the past decade, such funds have become an important alternative to deposits as a source of bank financing.[8] In our model, the stock of deposits depends critically on bank and public decisions about the amount outstanding of such non-deposit funds.

Demand For and Supply of Reserves

The short-run problem for a representative bank is financing a given (exogenous) stock of loans. Loans are exogenous in the short run because they are determined primarily by the public's demand for them. Banks set the loan rate on the basis of the marginal cost of funds, and then lend whatever is demanded by the public. They adjust the rate slowly, however, so that in the short run it is essentially fixed. The quantity of loans therefore is determined primarily by the public's demand, and thus is outside banks' immediate control.

Part of the bank's portfolio of loans is financed by its deposits. These too the individual bank views as exogenous. Deposit rates (like loan rates) are adjusted sluggishly by banks, so that each views the quantity of deposits in the short run as essentially outside its control, being determined instead by the public's demand.

Banks must finance the excess of loans over deposits by borrowing non-deposit funds from the public. Banks choose among the different types of non-deposit funds on the basis (among other things) of their relative costs, which largely reflect the rates of interest that must be paid to induce the public to supply funds.

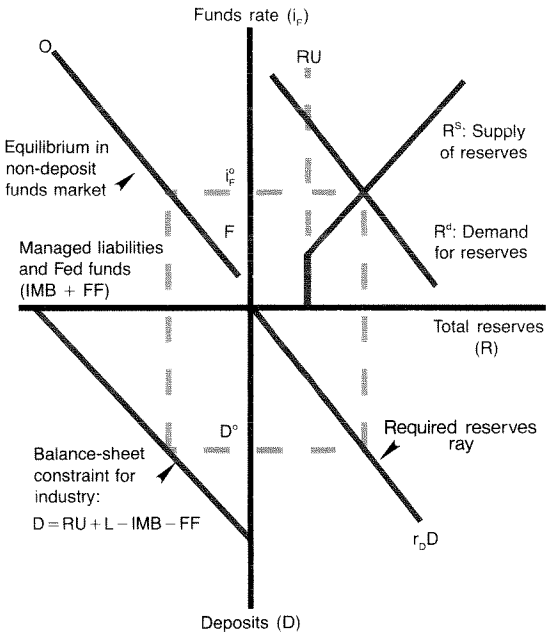
Central to the analysis is the role of the Federal-funds rate. Since Federal funds are substitutes from the banks' viewpoint for other non-deposit funds,[9] a higher funds rate is transmitted to other non-deposit rates as banks seek cheaper sources of financing. Higher rates of interest paid on non-deposit funds in turn cause the public to supply more of them. This they do by drawing on their deposit accounts, which causes the aggregate stock of deposits to fall. Thus, for a given stock of loans, the supply of deposits is effectively determined as a residual item on banks' balance sheets, with a higher funds rate being associated with a lower stock of deposits.

The division of the financing of the banking system's portfolio of loans between deposits and non-deposit funds in turn determines the banking system's need for reserves. A rise in

Federal-funds and other non-deposit rates is associated with a fall in deposits. The latter in turn means a reduction in banks' need for required reserves. Thus ultimately a higher funds rate is reflected in a smaller need for required reserves. This need can be thought of as the banking system's "demand" for reserves, so that equivalently one can say that a higher funds rate lowers the aggregate demand for reserves.

The supply of reserves to the banking system is also a function of the funds rate—in this case, an upward-sloping function. To the individual bank, borrowing from the Discount Window is a substitute for borrowing in the Federal-funds market. A higher funds rate therefore leads banks to begin borrowing from the Window, which means an addition to the total supply of reserves in the system.

Figure 1



Equilibrium in Reserves Market

In general there will be only one funds rate and associated level of deposits at which the demand for and supply of reserves are equal. This condition defines the short-run equilibrium for the money-supply model, as illustrated in Figure 1. The R^d curve in the northeast quadrant traces out the demand for reserves as a function of the funds rate, in the following manner. The 45-degree line in the southwest quadrant defines the balance-sheet constraint for the banking system, with its position determined by the exogenous quantities of loans (L) and nonborrowed reserves (Ru) held by the system. Its negative slope embodies the accounting tradeoff between deposits (D) and non-deposit funds (managed liabilities, IMB, and Fed funds, FF) as ways of financing this portfolio.

Each point on the balance-sheet constraint defines a different split of banks' liabilities between deposits and nondeposit funds. The curve OF in the northwest quadrant in turn associates a unique level of the funds rate with each such split. The curve is derived from the market-equilibrium condition equating the amount of non-deposit funds (IMB + FF) banks demand with the amount the public is willing to supply. It is upward sloping with respect to the funds rate, because interest rates on non-deposit funds must rise in order to persuade the public to supply larger amounts of such funds.

The split of banks' liabilities between deposits and non-deposits can also be associated with a unique level of required reserves by using the required-reserves ray, $r_D D$, in the southeast quadrant of Figure 1. Here, for simplicity, we assume that only deposits are reservable, with r_D being the required-reserve ratio. Each point on the budget line has a corresponding unique level of deposits, which in turn, with $r_D D$, defines a unique level of required reserves, R^d.

Finally, the curve R^d plots the combination of funds rate and required reserves that is consistent with each level of deposits in the banking system. It can be interpreted, as we mentioned earlier, as the banking system's demand for reserves. The quantity demanded is the amount of required reserves the system must hold given the level of deposits. The "price" of such reserves is the cost of acquiring them

in the non-deposit funds markets. Since Federal funds and managed liabilities (like large CDs) are substitutes, their rates move together, so that we can use the funds rate as the cost of acquiring reserves.

The supply of reserves, both borrowed and nonborrowed, is also depicted in Figure 1. The supply of nonborrowed reserves is determined almost entirely by Federal Reserve open-market operations. Nonborrowed reserves are shown graphically by the vertical curve RU in the northeast quadrant of Figure 1.

The amount of borrowed reserves is determined by banks' decisions about borrowing from the Federal Reserve versus borrowing in the nearest substitute market, the Fed-funds market. A higher funds rate causes banks to switch out of the funds market and borrow more from the Discount Window instead. Banks' aggregate demand for borrowing from the Window therefore is shown by the upward sloping curve BR* in the northeast quadrant of Figure 1. Adding BR* to the exogenous stock of nonborrowed reserves, RU, defines the supply curve of total reserves, R^s. Note that R^s is vertical over part of its range, reflecting the point that once the funds rate falls below the discount rate, member-bank borrowing becomes zero.

Short-run equilibrium is defined by the intersection of R^d and R^s. The equilibrium funds rate is i_F^o and the corresponding level of deposits is D^o. There are two dimensions to this equilibrium. First, the amount of nondeposit funds the public is willing to supply at i_F^o is equal to the amount banks need, given that deposits are D^o. Second, the amount of reserves that banks must hold when deposits are D^o equals the sum of what banks borrow when the funds rate is i_F^o plus the amount of nonborrowed reserves the Federal Reserve supplies.

Reserves Operating Procedures

The two curves, R^s and R^d, can be used to illustrate the nature of a reserves operating procedure (Figures 2a and 2b). In Figure 2a, D* is the target for deposits. For the banking system to produce deposits of D* means that required reserves must be $r_D D^* = R^*$ (We assume a contemporaneous accounting rule for illustrative purposes). Conversely, if total reserves are R*, banks will be in equilibrium only when deposits are D*. Hence R* is the amount of reserves that must be supplied in order to produce the target level of deposits, and therefore represents the Federal Reserve's target for total reserves.

Part of R* will be supplied by banks borrowing at the Discount Window. The Federal Re-

Figure 2a

Reserves Targeting

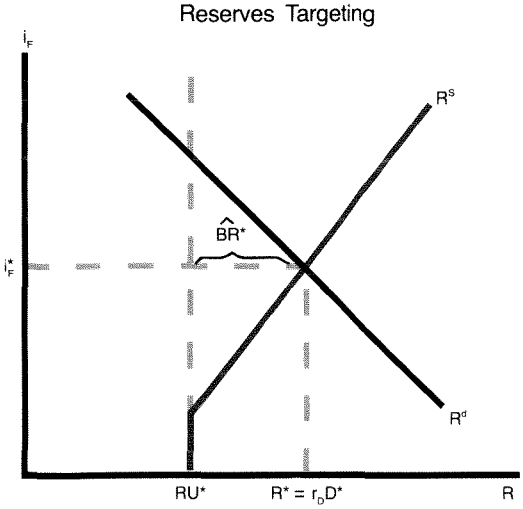
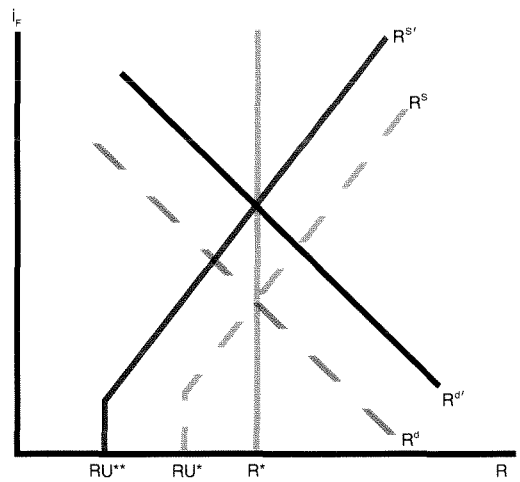


Figure 2b

Stabilizing Total Reserves



serve therefore must make an estimate of the amount of borrowing that is consistent with its total-reserves target. This will depend, among other things, on the level of the funds rate that corresponds to the total-reserves target, and on the discount rate. In Figure 2a, total reserves of R^* are consistent with a funds rate of i_F^*, which in turn implies borrowing of BR^*. The difference between R^* and BR^* measures the amount of nonborrowed reserves that must be supplied by the Federal Reserve, primarily through open-market operations. In Figure 2a, RU^* is that amount; it therefore represents the Federal Reserve's nonborrowed-reserves target.

Changes in either the R^d or R^s schedules in general will necessitate changing at least one of the targets. A change in R^d can occur, for example, because the public's demand for deposits has changed. In Figure 2b, a rise in the demand for deposits is illustrated by a rightward shift in R^d, reflecting the fact that a given funds rate is now consistent with higher deposits and therefore with higher required reserves. Deposits will not actually rise, however, unless total reserves are allowed to expand. Hence if the Federal Reserve wants to stick to its original deposit target, it must prevent total reserves from expanding.

The rise in the demand for reserves by itself can be expected to increase total reserves. A higher demand for reserves forces up the Federal-funds rate, which in turn drives banks out of the funds market and into the Window, causing borrowed reserves to rise. To counteract this, the Federal Reserve must drain off an equal amount of nonborrowed reserves. In other words, the Federal Reserve must revise upwards its estimate of borrowing and reduce its nonborrowed-reserves target by an equal amount. In Figure 2b, this is illustrated by a reduction in nonborrowed reserves to RU^{**}, which leaves total reserves at R^*. In this way, the Federal Reserve effectively converts an upward-sloping supply curve of total reserves, R^s, into a completely inelastic quantity of total reserves fixed at R^*—which is necessary, in this simple example, if the target for deposits is to be achieved. (This effective supply curve is shown by the vertical curve through R^* in Figure 2b.) However, in order to do so the Federal Reserve must predict the positions of R^s and R^d. Unpredictable shifts in either curve cause actual deposits to deviate from targeted deposits, D^*. These deviations represent monetary control errors, and their size depends on the reserve accounting scheme in effect. The remainder of this paper is taken up primarily with evaluating different accounting schemes on the basis of the amount of monetary control they provide—i.e., according to the size of the deviations from target they allow when shocks occur either to the demand for or supply of reserves.

II. Alternative Reserve Requirement Rules

The four reserve-accounting rules considered are:

1. Contemporaneous Reserve Accounting (CRA): $R_t = r_D D_t$
2. Lagged Reserve Accounting (LRA): $R_t = r_D D_{t-2}$
3. Marginal Reserve Accounting (MRA): $R_t = r_D D_{t-2} + (D_t - D_{t-2})$
4. Reverse Lag Accounting (RLA): $R_{t-1} = r_D D_t$

In the long-run, a given change in reserves and other variables (e.g., shifts in the demand for deposits or bank credit) have an equal effect on deposits under all four of these rules. This is true because in long-run equilibrium, $D_t = D_{t-1} = D_{t-2}$ and $R_t = R_{t-1}$. As a consequence, all four rules set reserve requirements equal to $r_D D_t$, the CRA rule. In the short-run, however, the choice of a rule has a potentially strong influence on the responsiveness of deposits to reserve and other changes. Thus the following analysis will focus on deposit control within a weekly context.

We examine in detail the responses of deposits and the funds rate to an *unexpected* shift in bank credit or deposit demand, under all four reserve-requirement rules. Following that analysis, we examine the responses to an un-

expected shift in bank demand for reserves from the Federal Reserve's Discount Window. Such unexpected shocks represent important sources of short-run money-control errors, so that it is desirable (ceteris paribus) to choose a reserve-requirement rule which minimizes these errors. However, rules which satisfy this criteria also tend to reduce the responsiveness of deposits to open-market operations, i.e., by requiring larger operations. But since a large open-market operation apparently costs little more than a small open-market operation, this feature of the rules deserves little weight.

Furthermore, rules which imply smaller deposit changes in response to shocks often imply larger funds-rate changes. Funds-rate variability has both positive and negative side effects. Unexpected changes in the funds rate can signal the Fed's Open Market Desk that money is deviating from its target, and can thus contribute to tighter monetary control. On the other hand, interest-rate variability at some point significantly disrupts the flow of funds through financial markets.[10] In recognition of this fact, the Fed sets ranges—albeit rather wide ranges—for the funds rate. For example, at the August 12, 1980 meeting of the Federal Open Market Committee (FOMC), the group set a range of 8 to 14 percent for the funds rate.[11] A reserve-requirement rule resulting in frequent violations of those bands would not be desirable within current operating procedures. Thus we should consider the effects of the four rules on extreme funds-rate variability and on the Desk's ability to prevent unacceptable variability.

Contemporaneous Reserve Accounting

First, consider what happens to deposits and the funds rate when exogenously determined bank loans rise under contemporaneous reserve accounting, or CRA (Figure 3). The reserve accounting rule is shown in the SE quadrant. We begin with the model in equilibrium at point A, which is also taken to be the target level of deposits. We next introduce a "shock" in the form of an increase in loans, and see how far from point A deposits move in the short-run.

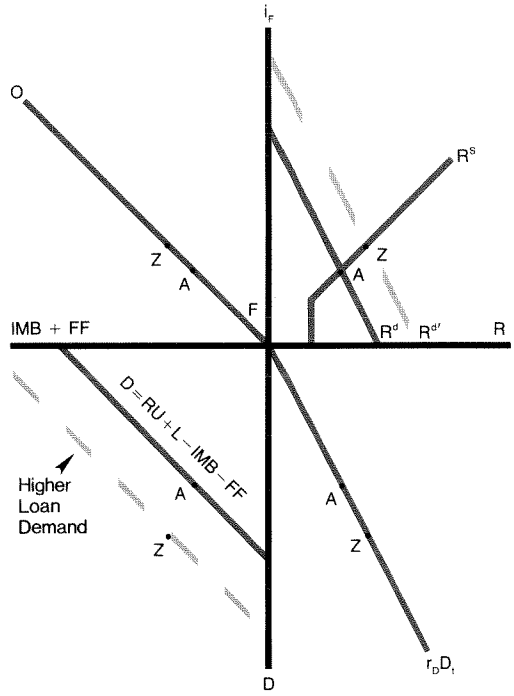
An increase in loans shifts the banking system's balance-sheet constraint equation downward (from solid to dashed line in the SW quadrant of Figure 3)—i.e., for any given level of managed liabilities, deposits must increase dollar for dollar with loans. Such a rise in deposits would increase banks' demand for reserves by the fraction r_D times the rise in deposits. This is reflected in the shift from the solid to dashed R^d line in the NE quadrant. Thus an increase in loans, together with the associated increase in reserves demand, causes deposits, the funds rate, managed liabilities, and reserves to rise from point A to point Z. The error in hitting the deposit target is measured as the distance from point A to Z on the vertical deposit axis. (It should be recognized that a bank-loan shift is illustrative of a number of other factors causing shifts in the R^d curve, such as shifts in the public's demand for demand deposits.)

Under CRA, the deposit-control error shown in Figure 3 represents both a short- and

Figure 3

Loan Demand Shift

Contemporaneous Reserve Accounting: $R_t \geq r_D D_t$



a long-run error. The CRA rule does not itself provide a distinction between short-run (or dynamic) effects and long-run (or equilibrium) effects, as the other reserves rules do. Thus, under CRA, any differences between the short- and long-run effects of a change in loans would depend on the banking system's partial adjustment behavior. The other three reserve rules, however, would produce dynamic deposit adjustments even with full adjustment by banks within the accounting period. In the remainder of the paper, we assume instantaneous adjustment, so that we can focus on the influence of the reserve rules themselves on reserve-market dynamics.

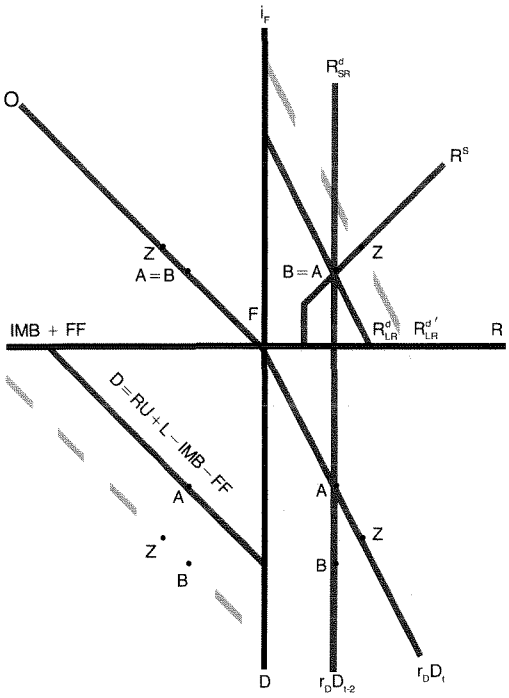
Lagged Reserve Accounting

Next, consider the dynamic response of deposits to a loan "shock" under lagged reserve accounting, or LRA (Figure 4). In the SE quadrant, LRA is represented by a vertical reserve-requirement line in the short-run, and thus a vertical short-run reserves-demand function (R^d_{SR} in the NE quadrant). In any given week, required reserves equal $r_D D_{t-2}$ and thus R^d does not respond to changes in current deposits or in the funds rate.[12] The long-run reserve-requirement line ($r_D D_t$ in the SE quadrant), and thus the long-run reserves-demand function (solid line marked R^d_{LR} in NE quadrant), are identical to their counterparts under CRA.

Figure 4

Loan Demand Shift

Lagged Reserve Accounting: $R_t \geq r_D D_{t-2}$



We again begin in equilibrium at point A (Figure 4), and assume that bank loans increase exogenously—represented by the dotted lines in the SW and NE quadrants. The funds rate is determined by the intersection of the short-run R^d function and the R^s function. Since R^d_{SR} is predetermined in any given week, the increase in loans has no effect on i_F. As a consequence, IMB + FF remains unchanged, and the entire increase in loans is financed with deposits. Thus in the current week, deposits increase beyond point Z—the same point Z as in CRA's Figure 3—to point B, indicating a larger money-control error than under CRA. In subsequent weeks, deposits oscillate around point Z, finally converging to it. Under this standard result, short-run control errors are larger with LRA than with CRA, but long-run errors are the same under the two rules.[13]

Also, under LRA, the funds rate does not change in the current week when bank loans rise, and thus provides no current-week signal to the Desk that deposits will exceed target. But this disadvantage for monetary control carries with it an advantage for bank reserve adjustment. The funds rate does not change in the current week because required reserves are not dependent on current deposits. This means that banks need not acquire contemporaneous deposit information to calculate their reserve requirements. Instead they need information on deposits two weeks previously, which is often much less costly to acquire. Of course, banks must still obtain contemporaneous information on their reserve holdings, but these data are more easily available, being kept by the Federal Reserve and supplied to banks with only a short lag.

The preceding analysis implicitly assumes that the funds rate is above the discount rate, and thus that Discount-Window borrowings are above frictional levels: i.e., reserve-market equilibrium occurs on the upward-sloping part of R^s. Once this assumption is dropped, monetary control under LRA is virtually impossible with a reserves instrument. Assume, for example, that bank loans declined, shifting the R^d curve so far to the left that the funds rate dropped below the fixed discount rate. Borrowed reserves will be at frictional levels, and reserve-market equilibrium will occur on the vertical portion of R^s. Thus in any given week, both R^s and R^d_{SR} are vertical, and there are no market forces determining the funds rate. As a consequence, the Fed in effect would have to revert to its previous funds-rate operating approach, and conduct open-market operations to fix the funds rate at some target level (i.e., the Fed would have to make R^s horizontal at the targeted funds rate). Thus the feasibility of monetary control with reserves under LRA depends heavily on the funds rate being sufficiently above the discount rate so that borrowed reserves exceed frictional levels.[14]

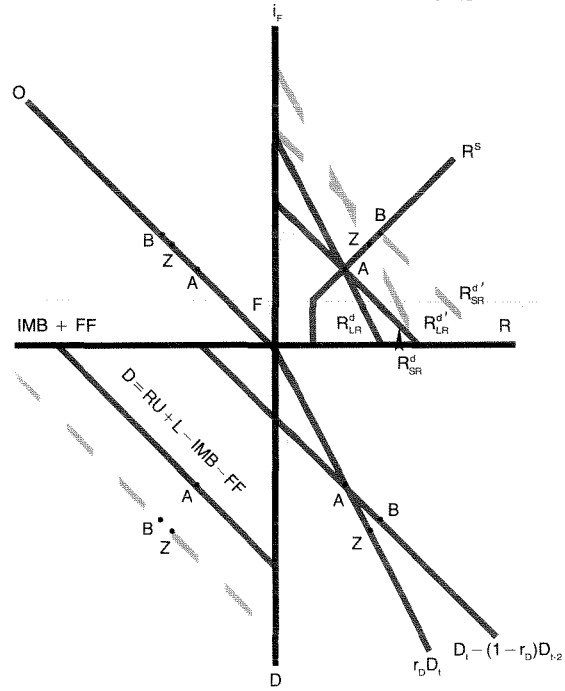
Marginal Reserve Accounting

Under marginal reserve accounting (MRA), banks are required to hold reserves according to LRA, plus 100 percent of the change in deposits over the preceding two-week period (Figure 5). The short-run 100-percent marginal requirement is plotted as the 45 degree line D_t - $(1-r_D)D_{t-2}$ in the SE quadrant, while in the long-run, reserve requirements are identical to CRA (denoted by the $r_D D_t$ line). Thus, MRA has a short-run advantage of 100-percent reserve requirements (i.e., a deposit multiplier with respect to total reserves of one), plus a long-run advantage of fractional reserve requirements (i.e., a banking system which can make loans).[15] Furthermore, this rule is designed to ease banks' reserve adjustments. Deposit inflows (expected or unexpected) have no current-week impact on banks' reserve excesses or deficiencies, because changes in reserves are met by equal changes in required reserves. In addition, any increase (decrease) in bank assets causes an equal increase (decrease) in banks' reserve position, no matter what the loan redeposit rate is.

Figure 5

Loan Demand Shift

Marginal Reserve Accounting: $R_t \geq D_t - (1-r_D)D_{t-2}$



As before, we begin (in Figure 5) at point A, and assume an exogenous increase in bank loans. In the current week, the funds rate increases to the intersection of R^s and R^d_{SR} in the NE quadrant (point B). This funds-rate increase is larger than under CRA (or LRA). The large rise in the funds rate, however, induces a *larger* increase in managed liabilities and thus a *smaller* increase in deposits than under CRA and LRA. The relatively small rise in current deposits reflects the dampening effect of 100-percent marginal reserve requirements on the current week's deposit change.

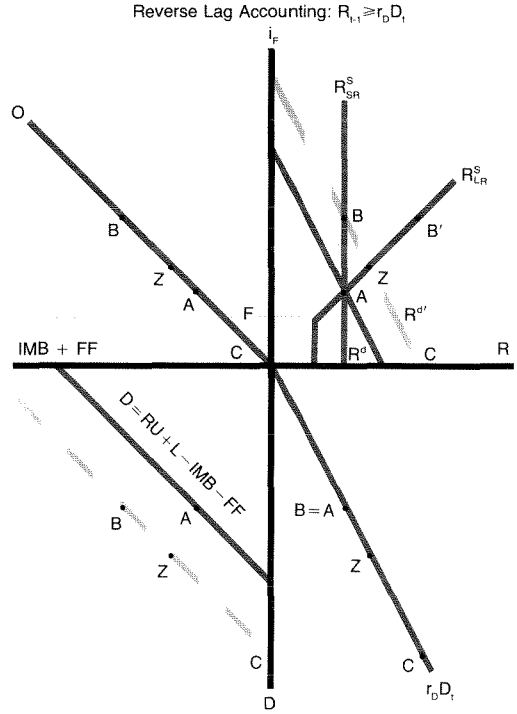
The larger increase in the funds rate under MRA also ensures that the Desk receives a strong signal that the aggregates may not be

on target. But the strong signal carries the risk that the funds rate will exceed the FOMC's tolerance band, especially in the short-run. An open-market operation done with the nonbank public (i.e., a nonbank government-securities dealer) would create an equal quantity of deposits and thus required reserves.[16] Since the higher supply of reserves would be met with an equal increase in reserves demanded, the funds rate would not change in the current week. The Desk could partially circumvent this problem by doing open-market operations directly with banks (i.e., a bank government-securities dealer) when it needed to control the interest rate. In this way, reserves could be supplied without immediately increasing deposits and thus required reserves.[17] Another possible solution would be to reduce Poole's proposed 100-percent marginal reserve requirement to, say, 75 or 50 percent. This change would in effect sacrifice some precision of short-run monetary control to gain some short-run interest-rate control.[18]

Figure 6

Loan Demand Shift

Reverse Lag Accounting: $R_{t-1} \geq r_D D_t$



Reverse Lag Accounting

Under reverse lag accounting (RLA), banks' required reserves are identical to CRA (SE quadrant of Figure 6), but the reserves which they can use to meet their requirements are those held in the preceding week. Thus reserves supplied in any given week are predetermined (see the vertical R^s_{SR} in the NE quadrant), and current deposits must change so that required reserves are brought into line with the fixed reserves supplied. This situation is just opposite to LRA. Under LRA, required reserves are predetermined in any given week, and the supply of reserves (either from open-market operations or the Discount Window) must accommodate the fixed demand. Another potential advantage of this proposal is that it includes three additional technical rules designed to lower the cost to individual banks of adjustment to reserve imbalances.[19]

Under RLA, the shift in bank loans (and thus in bank reserves demand) causes a large increase in the funds rate (intersection of the dotted R^d and the R^s_{SR}, point B), because the fixed reserves supply cannot accommodate even part of the higher demand. This large funds-rate increase is necessary if banks are to accommodate the increase in loans, since none of the new loans can be financed by increased deposits. Thus banks must bid up rates on Federal funds and managed liabilities by just enough to attract sufficient funds from the nonbank public to finance the loans. (IMB + FF increases from A to B in the SW quadrant.)

Such large funds-rate changes would present a problem for the Open Market Desk when that rate pierced the FOMC's tolerance band. The Desk would not be able to bring the funds rate back into the band in the current week, because that week's reserve injections could not be used by banks to satisfy reserve requirements until the following week. Thus the adoption of RLA would seem to require the FOMC to define its funds-rate bands over at least two-week and probably one-month periods.

The dynamic properties of deposits and the funds rate in the weeks following an increase in bank loans under RLA appear to depend importantly on whether borrowed reserves are positive or at frictional levels. Laurent (1979) suggests the desirability of eliminating the Discount Window under RLA, which presumably would involve maintaining the discount rate at a penalty above the funds rate.[20] Our analysis supports that conclusion.

With borrowed reserves at frictional levels, the vertical R^s_{SR} in Figure 6 would also be the long-run reserves-supply function, and the shift in bank loans would raise the new long-run reserve-market equilibrium to point B. Thus, the shift in bank loans would not affect deposits even in the long-run.

With significantly positive borrowed reserves, the long-run reserve-supply schedule would be positively sloped—shown by R^s_{LR} in Figure 6. In this case, banks would have to make two decisions whenever loans increase. First, they would have to decide how to fund those loans in the current week, resulting in a movement from A to B, as discussed above. In addition, banks would need to decide on Discount-Window borrowing in the current week. This borrowing would partially determine (along with the Desk's current-week open-market operations) the position of the fixed supply of reserves they face in the *following* week. The amount banks decide to borrow in the current week will depend on the current discount rate and the *following week's* expected funds rate and managed liability rate. If, for example, banks on average expect the funds rate to be at point Z in the following week, banks in the aggregate would borrow enough to put the R^S_{SR} at point Z at that time. With this accomplished, banks would be able to adjust their balance sheets to long-run equilibrium. As a result, deposits would move to the long-run equilibrium point Z in the second week and no further adjustments would be necessary. Under these circumstances, RLA would work like CRA with a one-week lag.

However, if banks on average were less successful at forecasting the future funds rate, the RLA rule would have uncertain effects on deposits, reserves and the funds rate. Assume that banks expect the funds rate to remain at the current week's level in the following week. The very high funds rate in the current week causes a high level of bank borrowing from the window (Figure 6, point B′).[21] The high borrowing means that the reserves supply in the following week increases substantially—the R^s_{SR} for week t+1 is a vertical line through

Table 1

Rankings of Reserve Requirement Rules: Unexpected Shift in Deposit or Loan Demand

	Positive Borrowed Reserves		Frictional Borrowed Reserves	
	Smaller Deposit Control Error	Smaller Funds Rate Change	Smaller Deposit Control Error	Smaller Funds Rate Change
Contemporaneous	2	2	1	1
Lagged	3	1	4	4
Marginal	1	3	1	1
Reverse	4	4	1	1

point B′. Thus, the funds rate falls and deposits rise sharply to point C in that week.[22]

We are not arguing that banks would in fact forecast in this particular way. But we would expect frequent errors in funds-rate forecasts on a week-by-week basis, considering that they are based on individual banks' forecasts of such factors as changes in aggregate bank credit, demand for deposits, and inflation expectations. Thus the short-run control properties of RLA would be unpredictable, depending on the week-by-week size and direction of funds-rate forecast errors.

Comparison of Rules

The four reserve-requirement rules may be analyzed in terms of the sizes of short-run deposit-control errors and Federal-funds rate changes. (In Table 1, a ranking of one indicates the *smallest* control error and the *smallest* funds-rate change.) With positive borrowed reserves, MRA outperforms CRA, which in turn outperforms LRA, in terms of short-run deposit control. RLA would rank last because of its more unpredictable and potentially larger control errors. While MRA is highly successful at insulating deposits from reserves-demand shocks, it results in larger funds-rate changes than either contemporaneous or lagged reserve accounting (although smaller changes than RLA). Moreover, both MRA and RLA would make it difficult for the Trading Desk to offset unwanted funds-rate changes.

The monetary-control advantages of MRA relative to CRA and RLA would be largely neutralized if borrowed reserves were at frictional levels. Under all three rules, a shift in deposit or loan demand would result in no deposit-control error (since R^s would be vertical), and an equal (large) change in the funds rate. Moreover, CRA would outperform RLA and MRA because of the contemporaneous impact of open-market operations on the deposit-supply curve. Thus in the face of external shocks, the Desk could keep the funds rate

Figure 7

Borrowed Reserves Demand Shift

Contemporaneous Reserve Accounting: $R_t \geq r_D D_t$

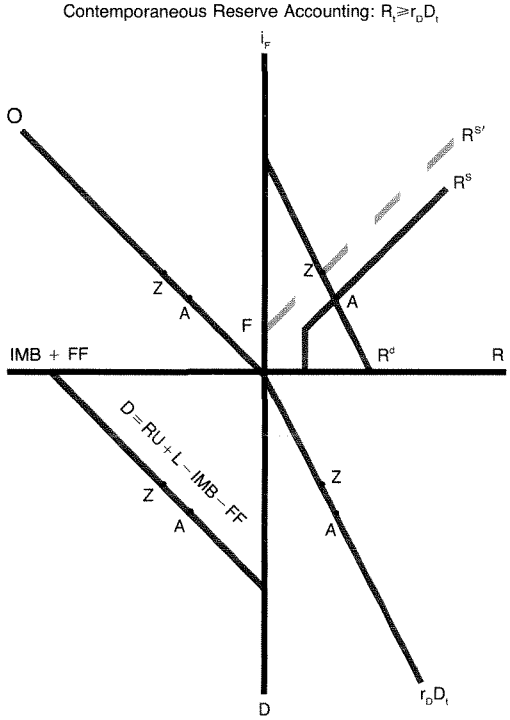
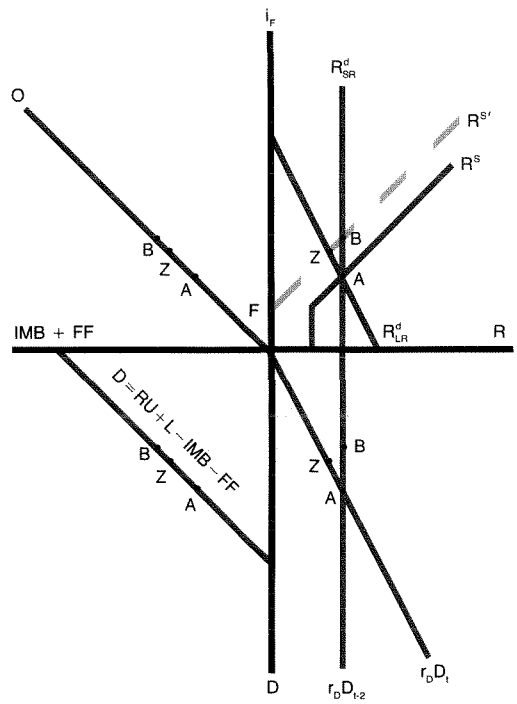


Figure 8

Borrowed Reserves Demand Shift

Lagged Reserve Accounting: $R_t \geq r_D D_{t-2}$



inside the FOMC's range under CRA, but would have difficulty doing so in the current week under the other two rules. Finally, under LRA, the reserves operating approach would be infeasible, and the Fed would most likely revert to its former procedure of setting funds-rate targets.

Shift in Demand for Borrowed Reserves

Up to this point, we have discussed in detail the short-run monetary-control errors resulting from an unexpected shift in the R^d function. Now we briefly present a similar analysis of an unexpected shift in the R^s function, caused by a change in banks' preferences for borrowing reserves from the Discount Window—in other words, a change in what is traditionally called banks' "reluctance to borrow" from the Discount Window. Figures 7–10 illustrate the issues involved with the example of a decline in banks' preference for borrowing, depicted by a leftward shift in the reserves supply schedule, Rs. In this case, rankings by control errors and funds-rate changes are the same. A rule that produces a large fall in deposits when borrowed reserves decline means banks must rely more heavily on managed funds, which produces larger increases in the funds rate.

Thus, for example, MRA restrains deposits to fall by only the reduction in reserves in the short run, and hence produces the smallest rise in the funds rate (Figure 9). CRA comes next because it causes deposits to fall by a multiple of the decline in borrowed reserves, putting more pressure on non-deposit funds including Federal funds (Figure 7). LRA does worst of the three because it requires a large fall in deposits in order to put enough pressure on the funds rate to force banks to borrow more from the Window despite their increased reluctance to do so (Figure 8).

RLA appears to provide the weakest monetary and funds-rate control of all if there is positive borrowing. In the very short run, there is no change in either deposits or the

Figure 9

Borrowed Reserves Demand Shift

Marginal Reserve Accounting: $R_t \geq D_t - (1 - r_D)D_{t-2}$

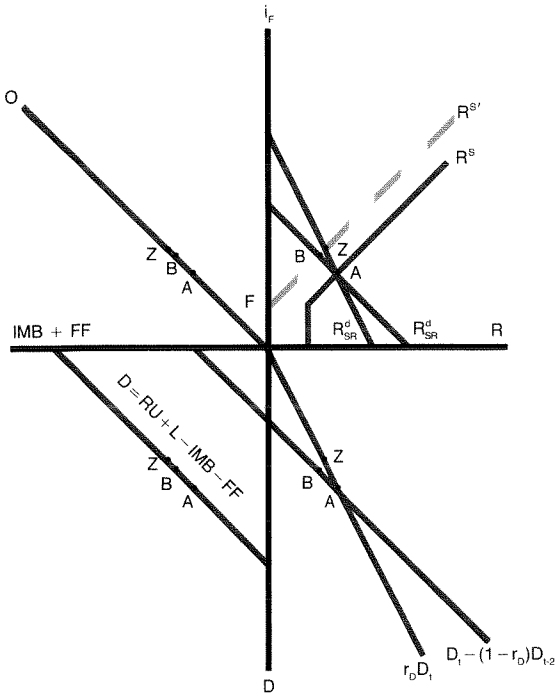
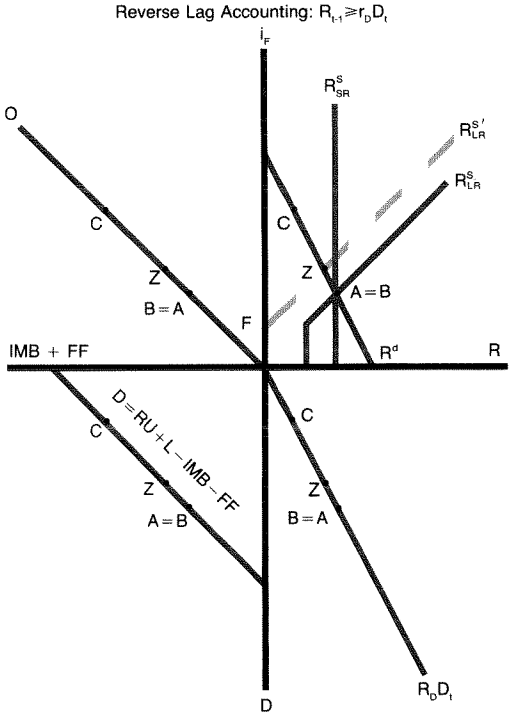


Figure 10

Borrowed Reserves Demand Shift

Reverse Lag Accounting: $R_{t-1} \geq r_D D_t$



funds rate (point B, Figure 10). As before, subsequent behavior depends crucially on how banks forecast future funds rates. Assuming an unchanged funds rate, for example, would cause banks to repay borrowing and put the system at C, producing a sharp rise in the funds rate in the next week and a large decline in deposits. However, since RLA apparently envisages reducing borrowing to frictional levels, it is not clear that it can be legitimately evaluated on the basis of its response to borrowing shocks.

Table 2 lists the rankings of the various rules for monetary control and funds-rate changes. It is clear from these rankings that for unexpected shifts in the reserves supply curve, Poole's MRA proposal is superior to CRA, LRA, and RLA on both criteria.

Table 2

Rankings of Reserve Requirement Rules: Unexpected Shift in Demand for Borrowed Reserves

	Smaller Deposit Control Error	Smaller Funds Rate Change
Contemporaneous	2	2
Lagged	3	3
Marginal	1	1
Reverse	4	3

III. Policy Implications

Policymakers' decisions on reserve-requirement rules depend importantly on the relative weights they give to controlling money and controlling the funds rate. If controlling money growth were the only objective, then marginal reserve accounting clearly would be the most effective rule to adopt. However, the Federal Reserve currently gives some weight to reducing the size of funds-rate fluctuations, despite its primary emphasis on controlling money. Under these circumstances, contemporaneous accounting appears to be the most effective rule. An alternative would be to modify marginal accounting by reducing the marginal reserve requirement from 100 percent to, say, 50 or 75 percent. Such a rule would provide somewhat greater emphasis on monetary control than is implicit in contemporaneous accounting.

The effectiveness of reverse lag accounting and lagged accounting depends critically on levels of borrowed reserves. If reserves are at significantly positive levels, the reverse lag could make monetary control highly unpredictable. When borrowed reserves are at frictional levels, the reverse lag provides for excellent monetary control, but no more so than under the marginal and contemporaneous rules. Moreover, the reverse lag would prevent the Fed from reducing current-week variability of interest rates.

Lagged reserve accounting, the rule presently used, can provide for adequate monetary control when borrowed reserves are significantly positive, though such control would be inferior to contemporaneous and marginal accounting. When borrowing is at frictional levels, lagged accounting makes a reserves operating approach inoperable, and thus requires the Fed to revert to direct funds-rate control. However, the lagged rule has one major advantage—a reduction in the costs of bank data-gathering activities. Thus the issue of abandoning lagged accounting, in favor of a contemporaneous or modified marginal rule, turns on the relative importance policymakers attach to increased bank costs versus increased accuracy of short-run monetary control.

APPENDIX
Formal Derivation of the Model

Bank Balance Sheet

The balance sheet for a representative bank is laid out in Table A1. A minimum of six categories of bank assets or liabilities appears to be necessary to preserve the usefulness of the model, both as a policy tool and as a foundation for an empirical model. These categories are reserves, R; bank loans, L; deposits, D; managed liabilities, IMB; member-bank borrowing, BR; and net Federal-funds purchased (including repurchase agreements), FF.

Table A1

Representative Bank Balance Sheet

Assets		*Liabilities*	
Reserves:	R	Deposits:	D
		Managed Liabilities:	IMB
Loans:	L	Net Fed Funds Purchased:	FF
		Member Bank Borrowing:	BR

On a monthly basis, bank loans are exogenous to the individual bank. They can be viewed as determined by the public's demand, given the bank loan rate. The latter, while ultimately determined by the banks, moves sluggishly or sporadically, so that for short periods of time it can be taken as given.

Deposits similarly are assumed to be exogenous, reflecting the fact that banks do not actively alter in the short run the terms on which they are willing to accept deposits. A bank's short-run portfolio choice therefore reduces to choosing the structure of non-deposit liabilities— among Fed funds, member-bank borrowings and managed liabilities.

Profit Maximization

We view bank portfolio choices as the outcomes of maximizing expected profit subject to the balance-sheet constraint. In the very short run, only IMB, FF and BR can be adjusted. Letting P stand for the expected profit function, the constrained maximum problem is:

$$\max H = P(L, R, D, IMB, BR, FF) - l(R + L - D - IMB - BR - FF) \qquad (A1)$$

The parameters of the expected profit function, P, include, among other things, the explicit interest costs of each of the three liability items— the rate on managed liabilities (CDs, for example) denoted by i_0, the discount rate, i_B, and the Fed-funds rate, i_F. The profit function also depends on the risk and liquidity characteristics of assets and liabilities, so that the marginal returns or costs of each portfolio item include a marginal non-interest element in addition to the explicit interest cost.*

The first-order conditions for a maximum are:

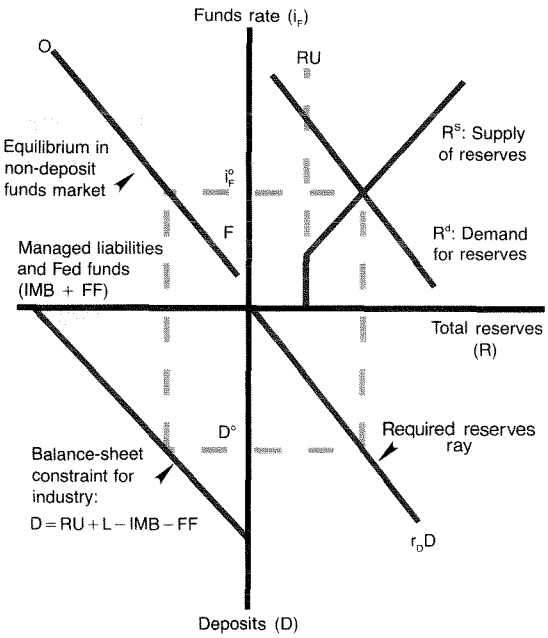
$$\partial P/\partial IMB + l = o \qquad (A2.a)$$
$$\partial P/\partial BR + l = o \qquad (A2.b)$$
$$\partial P/\partial FF + l = o \qquad (A2.c)$$
$$\partial P/\partial IMB = -i_0 - r_0 l - \tilde{P}_{IMB}(IMB, BR, FF) \qquad (A2.a')$$
$$\partial P/\partial BR = -i_B - \tilde{P}_B(IMB, BR, FF) \qquad (A2.b')$$
$$\partial P/\partial FF = -i_F \qquad (A2.c')$$

Equations (A2.a)–(A2.c) express the equilibrium condition that marginal costs should be equalized across liabilities, with l the common marginal cost. The companion equations (A2.a′)–(A2.c′) break down the marginal costs into their explicit interest component, and the associated non-interest cost represented by $\tilde{P}$.

*Ernest Baltensperger, "Alternative Approaches to the Theory of the Banking Firm," **Journal of Monetary Economics,** January 1980, pp. 1–38, distinguishes two types of non-interest costs. For liabilities, these include associated costs of liquidity management, e.g., differences in withdrawal risk, and costs of producing and maintaining deposit contracts. On the asset side, these include risks of default, and information and transaction costs associated with extending different types of credit. Baltensperger also includes differences in the cost of acquiring or disposing of an asset or liability.

Since only two of the equations are independent by virtue of the budget constraint, we can normalize on one of the marginal non-interest costs, which we take to be the non-interest cost of Fed funds. Thus $\tilde{P}_B$ represents the marginal non-interest cost of member-bank borrowing relative to the non-interest cost of borrowing in the funds market, and therefore naturally can be interpreted as the traditional "reluctance to borrow." In an analogous fashion, $\tilde{P}_{IMB}$ can be taken as a liquidity premium reflecting the fact that some managed liabilities (such as CDs, for example), typically have a longer maturity than Fed funds. Note that the interest cost for managed liabilities includes a term to cover the cost of additional reserves, where r_0 is the required-reserve ratio against managed liabilities and l the marginal cost of funds. Under lagged reserve accounting, of course, l should refer to the expected *future* cost of funds. Here, for simplicity, we assume that the expected cost of funds two weeks from now is today's rate.

Figure A1



Markets for Non-deposit Funds

Solving equations (A2) for IMB, BR and FF yields desired stocks for each as functions of interest rates, the required-reserve ratio against managed liabilities, and the "wealth" variable, L + R − D. These are listed on the left-hand side of equations (A3.a)–(A3.c).

If we interpret these bank demands as *aggregate* demands for the banking system as a whole, we can solve for market equilibrium by equating these demands to the corresponding market supplies provided by either the public (in the case of managed liabilities and Fed funds) or by the Federal Reserve (in the case of reserves). These supplies are shown on the right-hand side of equations (A3.a)–(A3.c). Thus IMB^d is the public's supply of managed-liability funds expressed as a function of the own rate, i_0, and a vector, Z, of exogenous determinants (other market rates not appearing in banks' portfolio decisions, and income). Similarly, FF^d is the supply of Fed funds by the nonbank public. In the reserves-market equilibrium equation (A3.b), R − RU is the amount of member-bank borrowing in effect supplied by the Federal Reserve through the Discount Window.

$$IMB^* = IMB^*(i_0, i_F, i_B, r_0, L+R-D) = IMB^d(i_0, Z) \quad \text{(A3.a)}$$

$$BR^* = BR^*(i_0, i_F, i_B, r_0, L+R-D) = R - RU \quad \text{(A3.b)}$$

$$FF^* = FF^*(i_0, i_F, i_B, r_0, L+R-D) = FF^d(i_F, Z) \quad \text{(A3.c)}$$

$$IMB + BR + FF = L + R - D \quad \text{(A3.d)}$$

$$R = r_D D \quad \text{(A3.e)}$$

Supply Model

The supply-model specification is completed by adding the banking industry's balance-sheet identity, equation (A3.d), and the required-reserves identity, equation (A3.e). (Here, for simplicity, we ignore required reserves on managed liabilities.) Equation (A3.d) implicitly yields the stock of deposits created by the banking system. Deposits for the system as a whole must be whatever is necessary to fund the excess of the system's asset holdings (L + R) over what is financed from non-deposit sources (IMB + BR + FF).

The system has three bank-demand functions, three supply functions of the public or Federal Reserve, one balance-sheet identity and one required-reserves identity. Because of the balance-sheet identity, however, one of the bank-demand functions is redundant. Hence there are seven independent equations to determine seven variables— Fed funds (FF), managed liabilities (IMB), member-bank borrowing (BR), deposits (D), reserves (R) and the interest rates on Fed funds (i_F) and managed liabilities (i_0). The solutions for these variables are functions of the exogenous variables— loans (L), the discount rate (i_B), nonborrowed reserves (RU), the required-reserve ratios on deposits (r_D) and the other determinants of the public's supply of nondeposit funds (Z).

To go from equations (A.3) to the curves in Figure 1, reproduced as Figure A.1 below, we proceed as follows. Two of the associations are trivial. The required-reserves ray in the southeast quadrant is obviously equation (A3.c). The balance-sheet identity in the southwest quadrant is obtained from (A3.d) by moving member-bank borrowing, BR*, to the right-hand side and subtracting it from total reserves, R, to obtain unborrowed reserves, RU.

Figure A2

Managed Liabilities Market

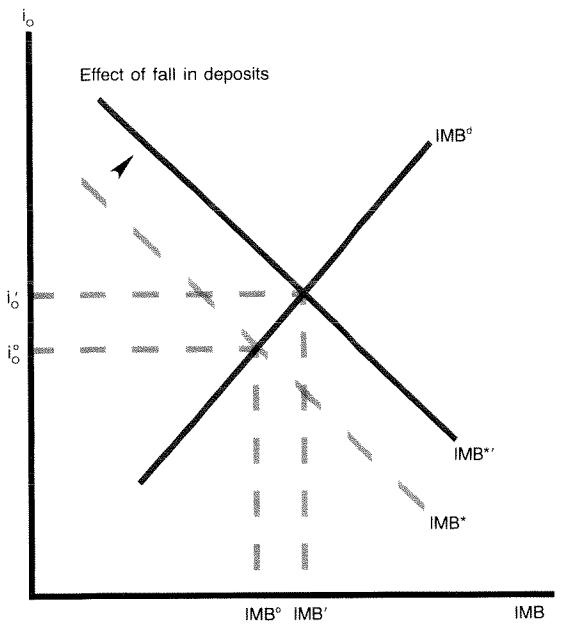
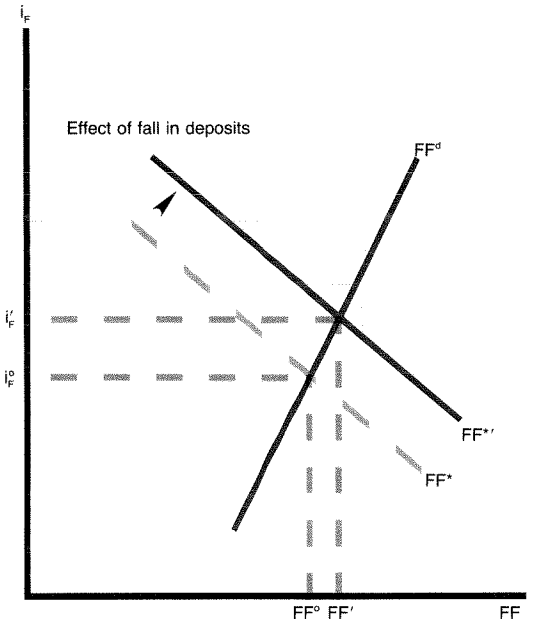


Figure A3

Fed Funds Market



The curve OF in the northwest quadrant of Figure A1 is obtained by using the equilibrium conditions in the managed-liabilities and Fed-funds markets— equations (A3.a) and (A3.c) respectively— to solve for IMB, FF, i_F, and i_0 as functions of D. The sum of the solutions for IMB and FF is then graphed against the solution for i_F to yield OF. Thus OF depicts all combinations of i_F and (IMB + FF) which are consistent with equilibrium in the markets for IMB and FF.

A heuristic description of how this process works is shown in Figures A2 and A3 below, which show respectively the markets for managed liabilities and Fed funds; in both cases the demand and supply curves are drawn with respect to their own rate— i_0 for managed liabilities, i_F for Fed funds.

Recall that the banks' demands for managed-liabilities funds and Fed funds, IMB* and FF*, are also functions of the "wealth" constraint R + L − D, which measures the fraction of banks' portfolios which must be supported by non-deposit sources of funds. An outflow of

deposits forces a bank to make up the loss by finding additional non-deposit funding. For unchanged rates of interest, banks will make up the deficit by increasing both the amount of managed liabilities they offer and the amount of Fed funds they demand. This is shown in Figures A2 and A3 by rightward shifts in the demand curves, IMB* and FF*. The net result is an increase in both managed liabilities and Fed funds, and an increase in the funds rate. Hence a rise in total non-deposit sources of funds is associated with a rise in the funds rate, as depicted by the curve OF.

Supply of Deposits

Following conventional practice, we assume that deposits are a function, among other things, of the commercial paper rate, i_{cp}. The supply curve of deposits, D^s, has a positive slope with respect to i_{cp}; this can be justified as follows. Presumably commercial paper is a substitute for banks' managed liabilities and Fed funds in the *public's* portfolios. Thus a rise in the commercial-paper rate can be expected to reduce the amount of managed liabilities the public wants to hold and the amount of Fed funds they are willing to supply. In Figure A1 this would be shown by a rightward shift in the OF curve, indicating, for an unchanged funds rate, a reduction in the amount of non-deposit sources of funds the public is willing to supply to the banking system. The banking system, in effect, must replace these funds with deposits. As a consequence, the banking system's demand for reserves would ultimately rise, showing as a rightward shift in the R^d function. The net result of a rise in the commercial-paper rate therefore would be an increase in the stock of deposits (and an increase in the funds rate, if not pegged). It is important to note that the avenue by which commercial paper rate changes affect the stock of deposits is the public's portfolio preferences for *non-deposit funds*. Thus disturbances to the demand for deposits, to the extent they affect the commercial paper rate, can affect the supply of deposits. But clearly such disturbances are not necessary for the stock of deposits to change: any disturbance that impinges on the public's supply of non-deposit funds to the banks will potentially influence the banks' supply of deposits to the public.

FOOTNOTES

1. See John P. Judd and John L. Scadding, "Conducting Effective Monetary Policy: the Role of Operating Instruments," **Economic Review,** Federal Reserve Bank of San Francisco, Fall 1979, pp. 23–37, and "The Fed Crosses the Rubicon," **Weekly Letter,** Federal Reserve Bank of San Francisco, October 19, 1979.

2. For other money market models, see F. Modigliani, R. Rasche and J. Cooper, "Central Bank Policy, Money Supply, and the Short-run Rate of Interest," **Journal of Money, Credit and Banking,** May 1970, VIII (1), pp. 137–48, and T.D. Thomson, J.L. Pierce, and R.T. Parry, "A Monthly Money Market Model," **Journal of Money, Credit and Banking,** November 1975, pp. 411–431.

3. See Warren L. Coats, "Lagged Reserve Accounting and the Money Supply Process," **Journal of Money, Credit and Banking,** May 1976, VIII (1), pp. 167–180; Daniel E. Laufenberg, "Contemporaneous Versus Lagged Reserve Accounting," **Journal of Money, Credit and Banking,** May 1976, VIII(1), pp. 239–246.

4. **Ibid.**

5. See William Poole, "A Proposal for Reforming Bank Reserve Requirements in the United States," **Journal of Money, Credit and Banking,** May 1976, VIII (1), pp. 137–148; John P. Judd, "Dynamic Implications of Poole's Proposed Reserve Requirement Rule," **Journal of Money, Credit and Banking,** November 1977, IX (4), pp. 667–671.

6. Robert D. Laurent, "Reserve Requirements: Are They Lagged in the Wrong Direction?," **Journal of Money, Credit and Banking,** August 1979, XI (3), pp. 301–310.

7. For more detailed theoretical development and empirical estimates of the model, see John P. Judd and John L. Scadding, "Liability Management and the Supply of Deposits, A Short-Run Model," **Economic Review,** Federal Reserve Bank of San Francisco, forthcoming, Winter 1981.

8. See Jack Beebe, "A Perspective on Liability Management and Bank Risk," **Economic Review,** Federal Reserve Bank of San Francisco, Winter 1977.

9. Thomas D. Simpson, "The Market for Federal Funds and Repurchase Agreements," Board of Governors of the Federal Reserve System, **Staff Studies,** July 1979, has detailed the growing importance of Federal funds and repurchase agreements as alternatives to managed liabilities for banks.

10. See Raymond Lombra and Frederick Struble, "Monetary Aggregate Targets and Volatility of Interest Rates: A Taxonomic Discussion," **Journal of Money, Credit and Banking,** August 1979, XI (3), pp. 284–300.

11. "Record of Policy Actions of the Federal Open Market Committee, Meeting held on August 12, 1980," **Federal Reserve Press Release,** Board of Governors of the Federal Reserve System, Sept. 19, 1980.

12. Under lagged reserve accounting, the Federal Reserve must supply the predetermined quantity of reserves demanded by banks. To be more restrictive, the Desk aims for lower unborrowed and higher borrowed reserves targets, and in so doing drives the funds rate up. The higher funds rate induces banks to raise offer rates on managed liabilities. As a result, non-deposit sources of bank funds rise and deposits fall.

13. See, for example, Laufenberg (1976). Our model also gives the standard result—the reserves market is stable (i.e., converges to a new equilibrium when disturbed) if R^d is more steeply sloped than R^s, and is unstable (i.e., continuously moves away from equilibrium when disturbed) if R^s is more steeply sloped than R^d. Since we know of no evidence that the reserves market has been unstable since October 6, we have drawn Figure 4 so that the reserves market is stable.

14. See John P. Judd, "Two Weeks Can Be A Long Time," **Weekly Letter,** Federal Reserve Board of San Francisco, August 1, 1980.

15. For a discussion of 100-percent reserve requirements, see Milton Friedman, **A Program for Monetary Stability,** Fordham University, New York, 1959, pp. 65–76.

16. The nonbank dealer who sold a security to the Federal Reserve would deposit the proceeds with a bank, causing reserves, required reserves, and deposits to rise by equal dollar amounts under marginal reserve accounting.

17. The bank dealer who sold a security to the Federal Reserve would deposit the proceeds directly in his reserve account at the Federal Reserve, without increasing the deposits issued by the commercial bank. Thus, reserves would rise, but there would be no immediate change in reserve requirements.

18. It would also sacrifice some of the advantages for individual-bank reserve adjustments discussed earlier, since current-week changes in deposits would not cause equal current-week changes in reserves **and** required reserves.

19. The first rule makes an individual bank's asset changes impact on its own required reserves, and greatly insulates a bank's required reserves from the asset changes of other banks. The second rule insulates a bank's required reserves from shifts between deposit categories with different reserve-requirement ratios. The third rule insulates a bank's required reserves from shifts between deposits and currency.

a. **Changes in a bank's reserves at the Fed that arise from deposit changes (e.g., from check clearings or wire transfers) would be called reserve clearings at the Fed (RCF). In computing required reserves, a bank's RCF to date in the settlement week would be subtracted from demand deposits.** A bank with positive RCF (i.e., presenting a greater value of checks and wire transfers than are drawn against it) to date in the settlement week would subtract an equal amount from its demand deposits at the end of that day. A bank with negative RCF would add an equal absolute amount to its demand deposits.

b. **All deposit changes within the week would be treated as demand deposits for reserve-requirement purposes.** A bank's required reserves at the end of each day would be equal to its required reserves at the end of the previous settlement week, except that net deposit changes to date within the week would be added to the level of demand deposits at the end of the previous week.

c. **Current vault cash would be subtracted from demand deposits in computing daily required reserves.**

See Laurent (1979), pp. 302–307.

20. Laurent (1979), p. 308.

21. At this high aggregate level of borrowing, a number of banks might borrow reserves in excess of their own anticipated reserves needs in the next week. However, with the funds rate expected to be as high as B′ next week, these banks would find it profitable to borrow reserves from the discount window this week in anticipation of making loans in the Federal-funds market next week.

22. In fact, the reserves market shown in Figure 6 is unstable if banks continuously expect no change in the funds rate from the previous week—i.e., the funds rate and deposits will oscillate in ever-increasing swings along with borrowing and the short-run supply of reserves. This result depends on R^s_{LR} being less steeply sloped than R^d. If the reverse were true—a relatively inelastic reserves supply schedule because borrowing is unresponsive to the funds rate—the reserves market would be stable, because the increase in the quantity of borrowed reserves would be small despite a sharp rise in the funds rate. Note, however, that these conditions would make LRA unstable.