



BOARD OF GOVERNORS
OF THE
FEDERAL RESERVE SYSTEM
WASHINGTON, D. C. 20551

December 15, 1976

CONFIDENTIAL (FR)
CLASS II FOMC

TO: Federal Open Market Committee

FROM: Arthur L. Broida *ALB*

Attached is a report of the Subcommittee on the Directive, dated today and entitled "Re-appraisal of nonborrowed reserves on basis of staff experiment."

It is contemplated that this report will be discussed at the forthcoming meeting of the Committee.

Attachments

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TO: Federal Open Market Committee

DATE: December 15, 1976

FROM: Subcommittee on the Directive
(Messrs. Partee, Chairman;
Wallich, Balles and Morris)

SUBJECT: Re-appraisal of non-
borrowed reserves on basis
of staff experiment.

At a special meeting on March 29, 1976, the Federal Open Market Committee held a discussion of the second stage report of the Subcommittee on the Directive, and in consequence asked the staff to experiment with the use of nonborrowed reserves as an operating target for the Desk in the periods between Committee meetings. While the focus was on nonborrowed reserves, the staff also tracked other reserve measures, such as total reserves and the monetary base.

The Open Market Committee has been kept up to date on this experiment through the Manager's weekly and monthly reports, his oral reports to the Committee, and the blue book. A detailed over-all analysis is contained in two attached staff papers. One--from the Trading Desk staff--describes actions the Desk believes it would have taken if it had been guided by a nonborrowed reserve target and the implications of these actions for the Federal funds rate, given certain constraints imposed on the experiment, such as that the funds rate be permitted to vary no more than 1/4 percentage point per week. The other--by Board staff--evaluates the staff's ability accurately to project the multiplier relationship between reserves and the monetary aggregates (M_1 and M_2) over an intermeeting period. This paper goes on to estimate whether M_1 and M_2 , during particular four or five week intermeeting periods, would have turned out to be closer to Committee expectations if a reserve target had in fact been achieved, assuming no Federal funds rate constraint.

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The Subcommittee on the Directive met with staff in October to discuss these results. This memorandum presents the subcommittee's evaluation of the experiment and contains our further recommendations with regard to the role of reserve measures in providing guidance to the Desk.

Before presenting our evaluation of the results, it should be noted that there were significant limitations inherent in the experiment as conducted. The experiment was necessarily static, not dynamic. Effects on the funds rate and the aggregates were estimated only for individual intermeeting periods, with each period considered independently from the preceding one. This procedure had to be followed because there was no way that the staff could reasonably judge how the FOMC in a subsequent meeting would react to new conditions created by efforts to attain a nonborrowed target in a preceding intermeeting period. While a combination of judgment and money market model results did permit rough estimates of effects on M_1 and M_2 from achievement of a nonborrowed reserves target in a particular intermeeting period, these tentative calculations could not be carried into the future without making further assumptions as to FOMC reaction to new projections of the aggregates that the staff would have been called upon to present.

Because of its static nature, the experiment naturally leaves unresolved questions. One is the effect on the aggregates--and on the economy--of changes in the behavior of banks and the public that might result from a shift to targetting on reserves in the short-run rather than a Federal funds rate. There is some reason to believe that the change in the response behavior of investors might, over time, lead to lessen day-to-day fluctuation in short-term interest rates than would

be expected when reactions are appraised in light of past responses to a change in the Federal funds rate. After a learning period under a reserve target, it seems probable that the banks and the public would become less sensitive to day-to-day fluctuations in the funds rate. On the other hand, the predictability of the relationship between reserves and the aggregates might well deteriorate somewhat if the public and the banks were to become more uncertain in their responses to changes in money market conditions on the thought that the changes might be no more than transitory.

Despite our inability to test such questions, we still believe that the experiment permits conclusions about the usefulness of a reserve target as an instrument for hitting a monetary aggregate target over a short-run operating period of four or five weeks. It does not, however, permit conclusions as to the value of a reserve target over a longer-run of three to six months; such conclusions have to be based on other evidence drawn from econometric research.

Design of the experiment

At each FOMC meeting over the past six or seven months, the staff, in an appendix to the blue book, projected reserve measures thought to be consistent with the three short-run alternatives for the monetary aggregates presented to the Committee. The appendix showed the average level of reserves--nonborrowed reserves, total reserves, or the monetary base--for the four or five week intermeeting period that was believed consistent with alternative two-month growth rates for the aggregates. After the FOMC reached a decision as to its short-run operating ranges for

M_1 and M_2 , the related nonborrowed reserve measure (which might have had to be modified from those presented depending on the particular M_1 and M_2 chosen by the FOMC) was taken by the Trading Desk as its operating target for experimental purposes.

The Desk then undertook to simulate operations as if that non-borrowed target were its operating guide. In the simulations, it did not generally look through to the monetary aggregates.^{1/} In addition, the originally set nonborrowed level was not modified during the inter-meeting period as new evidence became available that appeared to suggest a change in the originally assumed multiplier relationship between reserves and aggregates since such evidence typically was tentative and partial and no procedural rules had been established for considering it. Finally, the Desk operated within the Federal funds rate range adopted by the Committee for the interval. The Desk assumed it had flexibility to permit the rate to vary within that range, but by no more than 25 basis points in either direction from week to week.

Experimental results

(1) In four of the six intermeeting periods from March through September that were analyzed the simulated level of nonborrowed reserves turned out to be within \$50 million of the "targeted" level. The original recommendation of the Subcommittee on the Directive had suggested a range of plus or minus \$50 million around the "target" level. It would appear, therefore, that nonborrowed reserves were a technically

^{1/} In one period the Desk looked through to the aggregates to some degree, and in another some attention was given to an ongoing Treasury financing.

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feasible target most of the time, even within the funds rate constraints imposed. In contrast with the simulation, the actual level of nonborrowed reserves was within \$50 million of "target" only one time out of six.

(2) In four out of the six periods the simulated Federal funds rate would have been significantly different from the actual funds rate--with differences in a statement week in a 25 to 50 basis point range about one-third of the time. In all four of these periods, the funds rate would have been higher than actually developed. However, the significance of this asymmetrical result is limited by the lack of dynamic elements in the experiment; it is probable that the dynamics of the situation would have led to different funds rate movements, probably including periods of downward rate adjustment as the impact of earlier, more substantial upward rate adjustments worked through the financial system.

(3) Using a nonborrowed target, there would have been more week-to-week reversals of significant size in the funds rate during intermeeting periods--reversals of, say, 25 basis points or so. This would have occurred in part because of weekly revisions in forecasts of required reserves, which--with nonborrowed reserves given--cause changes in free reserves and in the funds rate. Thus, a nonborrowed reserve target would, as was expected, cause somewhat more week-to-week variation in the funds rate.

(4) Projections of the multiplier relationship between monetary aggregates and nonborrowed reserves proved most difficult over the short run. Even if the nonborrowed reserve target had been hit during an intermeeting period, the average absolute monthly deviation in M_1 growth from expectations would have been about 4-1/2 percentage points, at an annual rate. The average absolute percentage deviations in multipliers

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predicated on total reserves and the monetary base were also sizable, though a little less than for nonborrowed reserves. (Similar results were obtained for M_2 multipliers.) The magnitude of these deviations is generally consistent with evidence from a variety of econometric studies.

(5) Given the slippage in the short-run relationship between reserves and the monetary aggregates, the experiment suggested that there would be little or no improvement in the FOMC's ability to attain short-run (i.e., monthly or bi-monthly) objectives for the monetary aggregates, even if limits on the variation in the Federal funds rates were not used as a constraint. If it were assumed that the Desk actually hit the nonborrowed target, the staff estimates that the M_1 growth would have been closer to expectations only one-fifth of the time and further away three-fifths of the time. For M_2 , on the other hand, the simulation would have been closer three-fifths of the time. In any event, the magnitudes involved for M_1 and M_2 --with one exception--did not suggest that the deviations relative to actual results would have been significant.^{1/}

Conclusions and recommendations^{2/}

(1) On balance, the subcommittee would recommend against including a reserve objective in the short-run operating specifications given to the Manager. Evidence from the experiment of the past six months does not suggest that nonborrowed reserves--or any other reserve aggregate-- would improve the Committee's ability to achieve short-run

^{1/} The exception was the April-May period of rapid monetary growth when it is estimated that adherence to a nonborrowed target would have brought M_1 and M_2 growth rates 1 and 1-3/4 percentage points (annual rate), respectively, closer to target. In doing so, the funds rate would have been 1-3/4 percentage points higher.

^{2/} Supplementary comments of Governor Wallich and President Balles are appended.

objectives for the monetary aggregates. Thus, there appears to be no advantage to including a reserve measure as a short-run operating guide (in addition to the funds rate) in instructions to the Manager covering the interval between FOMC meetings. It might be argued that there is something to be gained by including a nonborrowed reserve guide to the extent that it would lead to more flexibility in the funds rate and to less market concern with funds rate movements as an indicator of monetary policy. However, the reserve measure like RPD, would probably become non-operational shortly unless the FOMC permitted the funds rate to fluctuate more; and even if the funds rate were permitted to fluctuate, the reserve guideline would not ensure closer short-run control of the aggregates under the present institutional structure.

(2) In order to provide background information for the Committee and the Desk, we would recommend (a) that the staff include in the blue book estimates of growth rates for the various reserve measures over the ensuing six months expected to be consistent with a movement in the aggregates toward the longer-run growth rates adopted for them by the Committee, and (b) that analysis of past monetary developments in the blue book should evaluate recent behavior of reserves in relation to such expectations. While it appears clear that a reserve guideline does not add significantly to short-run control of the aggregates, reserves could provide a useful check on policy actions pursued by means of a funds rate target, particularly over a longer-run period of six months or so. Considerable evidence for this was developed

in the earlier work done for the Subcommittee on the Directive.^{1/} The inclusion of material on reserves in the blue book would help provide a basis for continuing to include a reference to reserves in the directive. The subcommittee believes such a reference is desirable because observation of it would tend to reduce the danger that adherence to a funds rate target might cause the System to lose control of the aggregates, by allowing the funds rate to become an independent objective instead of an instrument.

(3) We believe that research and analysis on the subject of the relation between reserves and the monetary aggregates has, since the subcommittee was formed in 1973, been thorough and that, at this point, further study and experimentation by the FOMC is no longer warranted. We would suggest that the Subcommittee on the Directive might now be more usefully asked to explore other pertinent policy issues, including any of the following: (a) how short-run objectives for the monetary aggregates might better be related to longer-run growth ranges adopted by the FOMC; (b) how excessive dependence of the market on the funds rate and hence on weekly movements in the aggregates believed to foreshadow movements in the funds rate might be reduced; (c) how week-to-week variations in the money supply figures and their projections might most appropriately be reflected in Desk operations;

^{1/} The evidence was most recently updated and summarized in a memorandum of June 15, 1976, from Mr. Kalchbrenner to Mr. Axilrod entitled "The effects of averaging single-month monetary aggregates forecast errors over longer periods...." that was earlier distributed to the FOMC and is also included as an attachment to this report.

(d) issues involved in establishing a base for and up-dating longer-run ranges for the aggregates, including such questions as base drift and the role of levels of the aggregates as compared with growth rates; and (e) exploration of possible changes in concepts of money, and how these should be taken into account in the FOMC's selection of both short- and longer-run monetary guides.

December 15, 1976

Supplementary Comment of Governor Wallich

The nonborrowed reserves simulation has confirmed the impression, previously derived from econometric research, that nonborrowed reserves are about as effective as the funds rate in hitting the aggregates over a monthly period, provided that the NBR instrument is not constrained by the funds rate. This experimental result was achieved despite the facts that

- (1) the experiment was not dynamic, i.e., that it started from scratch each month, and
- (2) the Manager did not change the NBR path in the light of the incoming aggregates while, of course, he changes the funds rate within limits in the light of the incoming aggregates.

In any event, we know that, over six-month periods, both instruments can hit the aggregates with a high degree of precision, e.g., a one per cent error one-third of the time. This capability should be sufficient, since short-run errors are not likely to affect the economy. The choice between the funds rate and nonborrowed reserves must, therefore, be made on other grounds.

I believe that the problem with the funds rate is that, from being an instrument, it tends to shift to the role of objective. This has tended to happen from time to time in the history of the System. Inadequate control of the aggregates has at times been the result.

Because of the unsettlement and other damage that an unstable funds rate occasions, the FOMC understandably is unwilling to treat the funds rate purely as an instrument. As soon, however, as the market recognizes that the Committee is reluctant to move the funds rate more than the minimum necessary, and in particular to reverse its movements, the market inevitably will attach large significance to any movement that does occur. The Committee, in turn, observing the responsiveness of the market to the rate, becomes even more cautious about changing it. In that way, the Committee itself creates a condition in which the funds rate can only be moved at considerable cost, with the attendant risk that the aggregates may go out of control.

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With nonborrowed reserves as an instrument, on the other hand, the funds rate would become quite unstable. Initially this would unsettle the market. After an initial period, however, other short-term rates would probably cease to move closely with the funds rate and would react only mildly to a jumpy funds rate.

I believe that good control of the aggregates, even at the cost of an unstable funds rate, would be superior to a well-controlled funds rate with the aggregates in danger of going out of control. It need not be superior to a regime in which the funds rate is moved frequently and freely in order to maintain control of the aggregates. It will take a deliberate effort on the part of the Committee, however, to escape from the vicious circle in which reluctance to move the funds rate enhances the rate's impact on the markets, while enhancement of that impact increases the Committee's reluctance to move the rate.

December 15, 1976

Supplementary Comment of President Balles

First, I wish to associate myself generally with the comments on the report by Governor Wallich.

In my view, it is important that the FOMC strike a reasonable balance between interest rate stability on one hand and control of the monetary aggregates on the other. It is my judgment the pendulum has shifted too far towards interest rate stability at the cost of significant undershoots or overshoots from time to time in our twelve-month growth ranges for the monetary aggregates, which raises the problem of "base drift." By using a non-borrowed reserves target, I believe that we could improve the likelihood of keeping the monetary aggregates within the growth ranges we have specified, while also reducing counter-productive market reaction to changes in the Fed funds rate.

Moreover, I believe that this could be accomplished without unacceptable fluctuations in the funds rate.

In view of the above considerations, I find it difficult to give unqualified support to recommendation number one in the report--namely "On balance, the subcommittee would recommend against including a reserve objective in the short-run operating specifications given to the Manager." In my view, the above recommendation would be acceptable only if recommendation number two is vigorously pursued and made operational--namely, that the blue book would contain estimates of growth rates of various reserve measures that would be consistent with the twelve-month growth ranges in the monetary aggregates as specified by the Committee, and especially that the blue book would provide a careful analysis of the recent behavior of such reserve measures in relation to the specified growth ranges in the aggregates.

EXPERIENCE WITH NONBORROWED
RESERVES OPERATING TARGETS

The Subcommittee on the Directive in early 1976 recommended that the FOMC instruct the Manager of the System Open Market Account to pursue an objective for nonborrowed reserves between meetings, subject to certain constraints on movements in the Federal funds rate. The FOMC, in a special meeting held last March 29, suggested that the Trading Desk judgementally simulate open market operations under the alternative operating procedure for six months and prepare a report on its observations. This memorandum describes and evaluates the simulated results of operating to achieve a nonborrowed reserves (NBR) target over the six intermeeting periods beginning in March 1976.

While the Desk could probably have brought NBR reasonably close to the intermeeting path averages, the simulations cast doubt on the premise that strict pursuit of such a short-term reserve target would have fostered the FOMC's broad policy objectives. Since the Desk considered each intermeeting interval on its own, without estimating the effect on subsequent periods of the pursuit of NBR targets in earlier periods, it was not in a position to assess the cumulative impacts of the alternative operating procedure. If simulated nonborrowed reserves and interest rates had diverged from actual values in one period, no attempt was made to assess the effect of this on either the subsequent behavior of these variables or on the monetary aggregates.

Still, the simulations indicated that there would have been greater pressure exerted on bank reserve positions in most intermeeting periods. This would have developed even though, a good part of the time, incoming data showed acceptable or somewhat less than desired

growth in monetary aggregates. Perhaps more importantly, the Desk's weekly objectives would have been far more influenced by the incoming weekly data and projections--in this case of bank demand for reserves over an intermeeting period--than it presently is by revisions in estimates of monetary aggregates, given fairly wide ranges of tolerance for these measures. The frequency of forecast revisions increases the probability that under NBR targeting, open market operations would have to reverse direction--in terms of movements in the Federal funds rate--during intermeeting periods. Reasons for these conclusions and a description of how the simulations were done are provided in the discussion that follows. A detailed description of week by week simulated developments in one intermeeting period and a summary of hypothetical results for the other intervals is also given.

The guidelines and reserve paths used in the simulations:

At the start of the first statement week after each Committee meeting, the Desk received, from the Board staff, a path for nonborrowed reserves for the new intermeeting period. In conducting simulations, it was assumed that open market operations would be directed at achieving the indicated intermeeting average for nonborrowed reserves as long as such operations were not likely to cause the Federal funds rate to move outside of the constraints specified for that interval by the FOMC. If pursuit of the NBR target was expected to push the funds rate outside the range, the Desk would supply NBR at a pace designed to keep the funds rate at the relevant constraint in order to minimize the emerging deviation of NBR from path. It was also assumed that the FOMC would not want the weekly average Federal funds rate to change by more than 25 basis points

in either direction from one statement week to the next. While operations would be directed at achieving a specified average reserve level for the intermeeting period, deviations of \$50 million on either side of this average were considered acceptable.

The nonborrowed reserve targets were designed to be consistent with the two-month tolerance ranges established for M_1 and M_2 .^{1/} First, the deposit and currency levels associated with the midpoints of these ranges were specified. An estimate of the credit proxy was used to determine the member bank portion of demand and time deposits as well as the other categories of reservable liabilities. With lagged reserve accounting, deposits were specified for the period starting one week prior to the meeting until roughly two weeks before the next meeting.

After this, estimates of average reserve ratios were applied to each liability component, prior to adjustment for seasonal variation. Reserve requirements depend on the size of a bank as well as the category and initial maturity of its deposits. The forecasted average required reserve ratios thus seek to capture the variation in the composition and distribution of each deposit component at member banks.

The above procedure provided an estimate of the required reserve portion of the reserve target. The staff simultaneously developed a forecast of excess reserves for the

^{1/} This is only one of several approaches that could be used to estimate NBR paths such as estimating money multipliers or specifying a constant increment or decrement to an initial reserve level in order to achieve a desired growth rate for nonborrowed reserves.

intermeeting period. While excess reserves are quite variable from week to week, it was generally assumed that they would show no significant change--other than seasonal--on average over a four or five week period. The required and excess reserve components combined gave a "path" for bank demand for total reserves. An estimate of member bank borrowing was made and subtracted from this total to arrive at a path for nonborrowed reserves.

Member bank borrowing is sensitive to variations in the Federal funds rate relative to the discount rate. The Federal funds rate range that was used to estimate borrowing was the one associated in the Blue Book with the specifications chosen by the Committee for M_1 and M_2 --even if the FOMC specified a range for the funds rate that had a different midpoint or width. By choosing the funds rate range and borrowing level in this manner, it was sought to ensure that the nonborrowed reserve paths were estimates of the reserve growth consistent with attaining the long run objectives for the aggregates according to the time path suggested in the Blue Book alternative. As the Blue Book focuses on the relationship between money and interest rates, the reserve paths were thus deemed to be consistent with the interest rate behavior the staff believed was needed to attain the aggregates objectives. However, at times the staff may not have considered them to be consistent with the short-run constraints placed on the Federal funds rate by the FOMC.

Actions taken by the Desk during an intermeeting period were assumed to have no impact on deposit levels or on the banking system's demand for required reserves during the same four or five

week interval.^{2/} Deviations in required reserves from the initial forecasts were expected to show through to the behavior of the Federal funds rate in the following way. Given that the Desk would aim for the path level of NBR, a shortfall of required reserves (RR) would be reflected in an enlargement of free reserves (FR), while an overrun of RR would cause a diminution in FR.^{3/} Bank adjustments to achieve this free reserve position can be thought of as being induced by variations in the Federal funds rate relative to the discount rate. Excess reserves were generally assumed to show little or no response to interest rate changes so that the bulk of the needed adjustment would be reflected in member bank borrowing. If BR is already at minimal levels, it cannot decline much further, and an increase in FR would call for a rise in ER.

^{2/} With lagged reserve accounting, deposits and required reserves could only be affected for one half or three fifths of any intermeeting period. Thus, it is not plausible to expect such responses. Even with contemporaneous reserve accounting it seems implausible to expect significant impacts within an intermeeting period.

^{3/} This follows from the following identities:
 Total reserves (TR) = RR + Excess reserves (ER).
 Also, TR = NBR + Borrowed reserves (BR)
 Hence, RR + ER = NBR + BR.
 Rearranging these terms, ER - BR = NBR - RR
 ER - BR = FR (Free reserves)
 Thus, FR = NBR - RR, and if NBR is "fixed" as a target, then FR must rise as RR falls and vice versa.

Summary of the results:

a. Intermeeting periods:

The Desk found that in four of the six periods it could probably have achieved a nonborrowed reserves average that was within \$50 million of the indicated path.^{4/} In five, there would have been upward pressures on short-term interest rates though such pressures would have been temporarily reversed for a week or two during two of the intervals. In the two periods when higher Federal funds rates were actually sought, NBR targeting would have led to relatively higher rates. The implicit pressures on the funds rate in each period can be gauged in Table I where actual NBR levels are shown to be above the NBR paths and the levels that the Desk estimates it could have achieved. Table II compares weekly expected and simulated funds rates, estimated as arising from NBR targeting, to the objectives stated by the open market manager and to actual rates.

In four of the intermeeting periods, required reserves fell below the levels incorporated in the NBR path.^{5/} But in only one--the August-September period--would the shortfall have become evident in some easing of money market conditions, and that would have occurred quite late in the period. In two other intervals,

^{4/} This is based on the NBR estimate available two days after the end of a targeting period. Revisions occur subsequently, but they may not be available until three or four weeks later. Initial estimates appear to consistently overstate reserve supplies.

^{5/} The deviations in required reserves did not always reflect the behavior of M_1 and M_2 , since numerous other factors determine required reserves.

bank demand for excess reserves turned out sufficiently stronger than expected when the paths were prepared and this more than offset the demand shortfall in the required reserve component. In one other interval, the amount of member bank borrowing that was allowed for when the path was constructed could not have developed unless the Federal funds rate had risen from below to well above the 5 1/2 percent discount rate. Even though bank demand for required reserves subsequently fell short of the initial expectations, the residual borrowing need still implied a rise in the funds rate.

There were several periods during which other considerations could or would have caused the Desk to modify its objectives from rigid adherence to the nonborrowed reserve paths. In five hypothetical NBR objectives were affected by the constraints on and guidelines for weekly changes in the Federal funds rate--in four cases, increases and in the final period, a decrease. This caused the Desk to aim for the NBR levels consistent with the funds rate constraint in order to minimize the emerging deviation in NBR. In one intermeeting interval, the Desk felt it should modify objectives slightly because the firming in money market conditions implied by the NBR path conflicted with the rather weak behavior of the aggregates--which had actually prompted action to seek a decline in the funds rate. In another period, the Desk temporarily aimed for slightly higher than path NBR because the indicated rise in short-term interest rates could have jeopardized the success of the Treasury's quarterly refunding. For these

reasons, the simulated or hypothetical NBR levels seen in Table I are generally above the indicated NBR paths.

b. Weekly developments:

While the Desk would have been seeking to achieve an intermeeting average for NBR, it still needed a strategy that established objectives for each statement week. The procedure that was used began with an examination of the latest estimates of the difference between required reserves and the NBR path for the period as a whole. This produced an estimate of the free reserves that needed to emerge if the path was to be attained. After adjusting for an estimate of bank demand for excess reserves over the remaining weeks, the Desk could then determine the member bank borrowing levels that would need to be induced.^{6/} The Desk then set weekly NBR targets over the intermeeting period in a way that permitted borrowing (or free reserves) to rise or fall steadily as the average level indicated for NBR was being achieved. This type of smoothing procedure was expected to reduce the likelihood that money market conditions would respond to the erratic weekly fluctuations in deposits and required reserves.

As it turned out, projections of required reserves were often revised substantially during an intermeeting period. Column 1 of Table III shows the path levels of free reserves

^{6/} A more detailed description of how weekly targets were adjusted for the behavior of NBR in preceding weeks and how estimates of excess reserves were made appears in the attached chronological description.

consonant with the NBR paths. Column 2 shows the averages of these measures implied by the NBR path combined with estimates of required reserves made three days after the FOMC meeting. Column 3 shows the average free reserves as estimated toward the end of the intermeeting period.

In late July, for example, it initially appeared that the Desk would be generating free reserve levels of \$66 million (averaging Board and N.Y. estimates) and well above those anticipated at the time of the meeting. But just prior to the August FOMC meeting, it appeared that the banking system would need to hold -\$14 million of free reserves--that is, move into a modest net borrowed reserve position if the NBR path were achieved. While the Desk would have initially moved in a direction that would have led to money market conditions that were easier than the path anticipated--though not necessarily easier than prevailing conditions--it later discovered that, in fact, free reserves needed to turn out \$80 million lower than suggested by the initial estimate. As a result, the Desk would have had to reverse direction and generate a sizable deepening of free reserve positions toward the end of the period, both to offset the higher than expected RR level and the earlier more ample reserve provision. At that time, it found that the Federal funds rate ceiling would have prevented it from actually seeking the NBR needed to achieve the path.

A reserve strategy that seeks to minimize erratic changes in money market conditions depends on accurate forecasts of required reserves. Since the weekly estimates were often revised significantly during each interval, they would not have provided much help in this respect. For example, if the Desk started out aiming for

the "wrong" trend in free reserves in the first two weeks, it would need to aim for an even larger change in the opposite direction in the final weeks. To avoid this type of situation, one could attempt to achieve weekly path NBR levels--but this could produce even larger gyrations in week-to-week money market conditions unless the weekly path levels could be laid out ahead of time with far more accuracy than seems to have been achievable in recent experience.

Concluding comments:

The simulations suggest that in several periods the Desk's operations could have caused erratic moves in interest rates. Even though the simulations were not dynamic, it was hard to see how this would induce the asset adjustments, by banks and the public, that would help achieve the desired monetary targets. In concept, deviations in the aggregates should lead to similar deviations in the banking system's demand for reserves. Thus, if an NBR target is being pursued, the behavior of the aggregates would be expected to show through automatically to interest rates as banks would find themselves with insufficient or extra reserves. (Strictly speaking--with a lag of two weeks.) In the short run, however, the reserve-deposit multiplier does not appear to be very stable and it seems difficult to forecast using current techniques. Required reserves are not strictly determined by the deposit components of M_1 and M_2 so that unacceptable growth in these measures may not become evident in the behavior of this component of reserve demand. In cases where it did, bank demand for excess reserves could also deviate from the amount allowed for in reserve paths and thus offset or extend the impact, on total reserve demand,

of shortfalls or overruns in required reserves. These situations occurred in the simulations. It was generally assumed in the simulations that the volume of member bank borrowing was predictable and would not shift radically from week to week. But such shifts could have occurred in actuality. Since the Federal funds rate was below the discount rate in most of the intermeeting intervals under consideration, the Desk did not gain experience on how NBR targeting would affect borrowing in a more restrictive financial environment.

Table I

	(1) NBR Path <u>Midpoints</u>	(2) Simulated NBR <u>Level</u>	(2 - 1) <u>Deviation</u>	(4) Actual NBR*	(4 - 1) <u>Deviation</u>
March-April	33798	33836	+ 38	33889	+ 91
April-May	34052	34305	+253	34329	+277
May-June	33432	33462	+ 30	33489	+ 57
June-July	34222	34256	+ 34	34319	+ 97
July-Aug.	34018	34049	+ 31	34088	+ 70
Aug.-Sept.	33744	33683	- 61	33721	- 23

* Two days after the end of the targeting period.

Table II

HYPOTHETICAL AND ACTUAL FEDERAL FUNDS RATES

		<u>Under NBR Targeting</u>		<u>Actual Procedures</u>	
		<u>Hypothetical expectation</u>	<u>Hypothetical result</u>	<u>Objective</u>	<u>Effective rate</u>
March	24	4 3/4	4 3/4	4 3/4	4.77
	31	4 7/8	5.05	4 3/4	4.84
April	7	4 3/4-7/8	4 7/8	4 3/4	4.73
	14	5-5 1/8 *	5 1/8	4 3/4	4.77
	21	5 1/4*	5 1/4	4 3/4	4.78
April	28	4 7/8	4 7/8	4 7/8	4.93
May	5	5 1/8	5 1/8	5	5.03
	12	5 1/8-1/4	5 1/8-1/4	5 1/8	5.02
	19	5 1/4*	5 1/4	5 1/4	5.28
May	26	5 3/8-1/2	5 1/2	5 3/8-1/2	5.50
June	2	5 5/8-3/4	5 3/4	5 1/2	5.54
	9	5 1/2	5 1/2	5 1/2	5.44
	16	5 3/4*	5 3/4	5 1/2	5.47
	23	5 3/4*	5 3/4	5 1/2	5.48
June	30	5 5/8	5.65	5 1/2	5.58
July	7	5 1/2	5 1/2	5 3/8-1/2	5.37
	14	5 1/2-5/8	5.45	5 1/4	5.27
	21	5 1/2-5/8	5 5/8	5 1/4	5.30
July	28	5 3/8	5.20	5 1/4	5.28
Aug.	4	5 3/8-1/2	5.42	5 1/4	5.36
	11	5 5/8-3/4	5.65	5 1/4	5.25
	18	5 3/4*	5 3/4	5 1/4	5.29
Aug.	25	5 1/4-3/8	5.31	5 1/4	5.28
Sept.	1	5 5/16	5.31	5 1/4	5.28
	8	5.20-25	5.31	5 1/4	5.25
	15	5.15-25	5.25	5 1/4	5.22
	22	5*	5	5 1/4	5.21

* NBR target affected by constraint on the funds rate

Table III

<u>Board</u>	<u>Board Path FR</u>	<u>FR needed three days after FOMC</u>	<u>FR needed Friday prior to next FOMC</u>
Mar.-April	+176	+114	+ 90
April-May	+ 91	+138	-128
May-June	-113	- 57	- 16
June-July	+ 71	- 24	+128
July-Aug.	- 35	+ 21	- 14
Aug.-Sept.	+ 92	+ 65	+183
 <u>FRBNY</u>			
Mar.-April	+176	+176	+ 90
April-May	+ 91	+207	-128
May-June	-113	-128	- 16
June-July	+ 71	+ 79	+128
July-Aug.	- 35	+110	- 14
Aug.-Sept.	+ 92	+ 65	+183

PART II: A TECHNICAL DESCRIPTION OF OPERATING TO ACHIEVE NONBORROWED RESERVES TARGETS

In simulating operations under an NBR objective, the Desk near the start of each week would examine the difference between path NBR and the latest projections of required reserves for the full intermeeting period. This showed the average level of free reserves that would emerge if the NBR path was achieved (assuming that required reserves would not respond significantly to Desk operations within an intermeeting period).

After deriving the free reserves needed to achieve the NBR path for the intermeeting period, the Desk would set initial reserve goals for a statement week in a way that achieved the NBR goal and was likely to establish a trend in member bank borrowing. It was assumed that excess reserves would show little interest elasticity but borrowing would be responsive to the differential between the Federal funds rate and the discount rate. The procedure for setting weekly goals would thus minimize fluctuations in the Federal funds rate.

The initial "trend" goal for the week then beginning was adjusted to take account of the likely variation in bank demand for excess reserves. (This was done under the assumption that weekly variations in the demand for excess reserves were likely to be offsetting given the carryover privileges available to member banks.) After a week was over, the Desk would assess actual developments and use them to estimate hypothetical NBR and FR levels. It was generally assumed that hypothetical open market operations were fairly similar

to actual operations--although the volume of reserves hypothetically provided or absorbed was adjusted in light of the weekly target.^{2/} The Desk would then compare initial weekly estimates of bank demands for borrowed and excess reserves to the evidence provided about such demands by actual bank and Federal funds rate behavior, during the statement week.^{3/} Before estimating the likely behavior of the funds rate the Desk would consider whether errors in estimating reserve demand would have caused a modification of the target and of operations. For example, if developments over a week suggested that bank demand for excess reserves had been underestimated, the Desk might have let FR and NBR move above their goals to higher hypothetical levels anticipating, at the same time, that such demands would show an offsetting variation in a subsequent week. In fact, it might have to do this to prevent the Federal funds rate from rising by more than the allowable 25 basis points. The estimated hypothetical levels of NBR for previous weeks were combined with the NBR path for the period as a whole before target levels were set for remaining weeks.^{4/}

^{2/} In the short run, actual open market operations are dominated by periodic or seasonal variations in market factors so this assumption is plausible.

^{3/} This became more complex as an intermeeting period progressed. While initial starting conditions were the same in the first week, they would begin to diverge in subsequent weeks; for example, the starting point in the second week, on the simulated NBR approach, would depend in part on the hypothetical result achieved in the first week under the NBR approach--and so on through the intermeeting period.

^{4/} The Desk also had to fold in any revisions in NBR for earlier weeks and errors in estimating the reserve impact of variations in market factors that were not discovered until after a week was over. It was believed that the \$50 million leeway around the path midpoint would be sufficient to accommodate such errors--that is if the Desk operated to achieve the path midpoint, market factor errors at the end of statement weeks could be at least partly offset later on and, when combined with the error on the final day of an interval, would not move NBR more than \$50 million away from path.

In establishing hypothetical reserve targets and simulating hypothetical levels the Desk made an estimate of the likely behavior of the Federal funds rate over a statement week. This was done to enable comparison with current procedures and to assess whether the targets were consistent with the range and guidelines specified for this rate. While no exact behavioral functions were assumed or specified, the following description indicates how the Desk judgmentally derived an estimate of the Federal funds rate from the hypothetical free reserve targets and levels.

The relationship between free reserves and the Federal funds rate contains "discontinuities" or "kinks" which needed to be taken account of in estimating the hypothetical results of operating under an NBR target. Bank demand for excess reserves is rather interest rate inelastic in the short run while borrowing is responsive to the differential between the Federal funds rate and the discount rate.

If achieving the NBR path meant large positive free reserve positions, the Federal funds rate would remain or move below the discount rate, thus keeping borrowing at a frictional minimal level or inducing banks to repay any amounts above this level. After that, further increases in free reserves could only add to holdings of excess reserves and the behavior of the Federal funds rate would depend on the interest elasticity of the demand for excess reserves. (Since this elasticity is low, the lower Federal funds rate constraint, or the assumed 25 basis point limit on weekly moves in the funds rate, would be likely to prevent the Desk from reaching the NBR target in such cases.) If achieving the NBR path meant large negative free

reserve positions the Federal funds rate would remain or move above the discount rate. The behavior of the Federal funds rate would in these cases depend on the combined interest elasticity of the demand for borrowed and excess reserves--although, as noted, for excess reserves this elasticity is probably insignificant relative to the interest elasticity of borrowing. Thus, the elasticity of free reserves with respect to the funds rate changed, depending on whether the rate was above or below the discount rate.

In the simulations, the Desk generally used past experience as a guide to the relationship between changes in borrowing and changes in the Federal funds rate for those periods when anticipated borrowing was above the frictional level. There was little opportunity to evaluate these estimates because borrowing was frequently near frictional levels. It appears likely that bank use of the discount window depends on the expected differential between the discount rate and the funds rate as well as the current differential. Moreover, the administration of the discount window could cause borrowing behavior to shift during protracted periods of monetary restraint. The borrowing function is probably nonlinear with respect to the current differential.

It should also be noted that the size of the likely change in the Federal funds rate as banks adjust to indicated FR holdings also depends on the level of the rate. Suppose, reaching the NBR target implied that the use of the discount window would be rising from a frictional level to about \$150 million, on average. The funds rate

would clearly be bid up to a level that was above the discount rate. If the funds rate were starting at 5 1/4 percent prior to the indicated adjustment, and the discount rate was 5 1/2 percent, the funds rate would increase by at least 25 basis points, whereas if the funds rate started at 5 percent the estimated increase would be roughly twice as large. Conversely, the estimated decline in the funds rate would depend on how far above the discount rate the funds rate is when NBR targets imply a drop in borrowing from a sizable to a frictional amount.

The above relationships between free reserves and the funds rate were not necessarily seen as pertaining to the weekly average Federal funds rate. In many cases, the Desk assumed that banks would not become aware of a significant change in reserve availability-- either deficiencies or surpluses --until the end of a statement week. Thus, while the expected change in the Federal funds rate needed to clear the market for bank reserves might have been fairly large, most of the adjustment was often expected to occur on the settlement day. The weekly average change would not be nearly so large and less likely to violate one of the specified constraints. It was also assumed that a volatile funds rate on the settlement day would not subsequently affect bank behavior and expectations. Presently, the funds rate is often quite volatile on Wednesdays. However, under current operating procedures the Desk typically responds to significant changes in the funds rate on the settlement day, even though its actions may at times have little effect on the rate. Under NBR targeting such responses might not be forthcoming and this could

affect subsequent behavior. The simulations did not explicitly seek to take account of this problem.

An actual case: the July-August intermeeting period.

The following description of likely developments in the July-August intermeeting period illustrates how the Desk applied the above procedures. It should be noted that the estimates of hypothetical NBR and FR levels became more difficult to make as an intermeeting period progressed because hypothetical developments diverged significantly from actual ones.

The NBR path showed an initial FR level of -\$35 million for the four week period. If excess reserves were to average \$163 million, member banks would be borrowing \$198 million on average from the discount window.^{5/} This compared to average borrowing of \$132 million in the preceding four weeks when the Federal funds rate had averaged 5.38 percent. Thus, the path seemed consistent with a firming in the money market. In fact, the path free reserve level was derived from the 5 1/4 to 6 1/4 percent range for the Federal funds rate shown in alternative C of the Blue Book rather than the lower 4 3/4-5 3/4 percent range actually specified by the FOMC. Reasons for this procedure are given in part I of this paper.

Shortly after the FOMC meeting, estimates of required reserves for the intermeeting interval were revised down significantly.^{6/} It appeared that banks would need to borrow only \$97 million, on average. It was thought that this volume of borrowing could develop if there

^{5/} In weekly reports, the paths and estimates for ER and BR were often rounded to the nearest \$5 million, rather than pinpointed exactly. In this paper, they are given exactly so that they are consistent with the data in the tables.

^{6/} The Desk used the average of Board and New York staff estimates of required reserves. In many cases, the figures reported were not received until a few days after a statement week started, as initial forecasts were revised.

were a gradual firming in the money market over the four weeks. Borrowing could average \$85 million in the first statement period and rise by \$10 million or so per week thereafter. In setting a hypothetical reserve goal for the July 28 statement week it appeared that ER would be somewhat below normal--around \$125 million--in view of the volume of reserves carried in from the July 21 week. The Desk believed that the hypothetical FR and NBR goal for the week was consistent with the Federal funds rate rising from the prevailing 5 1/4 percent to around 5 3/8 percent, on average. This implicitly assumed that the funds rate would rise to the 5 1/2 percent discount rate on the settlement day--or perhaps a bit earlier. The following table illustrates how the first week's goals could be related to the path and to future goals.

RESERVE ESTIMATES: July 23 (Millions of dollars)
Daily average, not seasonally adjusted

	Free Reserves FR	Excess Reserves ER	Borrowed Reserves BR
1. Intermeeting path avg.	- 35	163	198
2. Average estimated on 7/23	66	163	97
3. Cumulative amount estimated for the four week interval	264	652	388
4. Hypothetical goal for week of 7/28	40	125	85
5. (3) - (4) cumulative amount estimated for remaining three weeks	224	527	303
6. Average estimated for remaining three weeks	75	176	101

Developments during the July 28 statement week suggest that the Desk overestimated bank demand for ER. Since reduced demand in one week is often followed by increased demand later on, the Desk probably would have accepted the emerging shortfall in NBR and FR. At the time, it was estimated that ER would have turned out at \$50 million. However, the demand for even this small amount of excess reserves would not have emerged until the settlement day, as banks were evidently willing to accumulate rather large deficiencies until that time. This would have caused the Federal funds rate to drift lower, rather than higher as expected and would probably have caused the Desk to be willing to let FR and NBR run well below the hypothetical goals until the demand emerged on the final day. Given the estimated pattern of reserve supplying operations, which were fairly similar to actual operations, NBR would have ended up \$90 million below the hypothetical goal. With FR at -\$50 million, banks would have borrowed \$100 million--mostly on the settlement day. While the Desk's initial expectation for the Federal funds rate was around 5 3/8 percent, it appeared that the rate would have averaged a bit below 5 1/4 percent given the reduced bank demand for reserves, on average.

In the August 4 week estimates of required reserves for the four weeks were revised higher so that FR needed to reach path was now \$41 million, on average, for the four weeks. Assuming that excess reserves would still turn out at the \$163 million originally expected, borrowing was now

anticipated to average \$122 million for the four weeks and \$129 million in the remaining three. It appeared that this would occur if the money market were to firm but at a more pronounced pace than anticipated a week earlier. In the new week, borrowing could rise to about \$125 million--again mainly occurring on the final day--if the average funds rate were to move to 5 3/8 percent or perhaps somewhat higher. The Desk adjusted the NBR and FR goals for the August 4 week to reflect its expectation that demand for ER would rebound and be above average, at \$250 million. This showed the following:

RESERVE ESTIMATES: July 30 (Millions of dollars)

	<u>FR</u>	<u>ER</u>	<u>BR</u>
1. Path average	- 35	163	198
2. Average estimated on 7/23	+ 66	163	97
3. Average estimated on 7/30	+ 41	163	122
4. Cumulative amount estimated for the four-week interval	164	652	488
5. Hypothetical level for week of 7/28	- 50	50	100
6. (4) - (5): cumulative amount estimated for remaining three weeks	214	602	388
7. Hypothetical goal 8/4 week	125	250	125
8. (6) - (7): cumulative amount estimated for remaining two weeks	89	352	263
9. Average estimated for remaining two weeks	45	176	132

Developments in the August 4 week suggest that the Desk underestimated the demand for excess reserves and that undue money market pressures on the settlement day would have prompted it to bring NBR above its hypothetical goal. The hypothetical FR level would have been about \$215 million, about \$90 million above the hypothetical goal and NBR would have been likewise \$90 million above its goal. It is estimated that excess reserves would have been \$340 million and borrowing \$125 million. It appeared that the Federal funds rate would have averaged somewhat above 5 3/8 percent.

At the start of the August 11 week, estimates of required reserves were revised upward again so that to achieve the NBR path implied FR of close to 0 for the four weeks. In view of the hypothetical levels estimated for the previous two weeks and subsequent revisions, FR needed to deepen to -\$89 million on average, in the final two weeks. It was assumed that demand for excess reserves would average \$165 million in those weeks, which would bring the average for the four weeks to \$185 million--or somewhat above the path expectation. Member bank borrowing would need to rise from \$113 million to an average of over \$250 million. If the Desk were to hold back in providing NBR and thereby induce such a sharp rise in borrowing, then the Federal funds rate would be bid up to the discount rate and perhaps by more than the 25 basis points per week change used as a guideline in the simulations. To provide as few NBR and come as close to path as possible, the Desk would have set hypothetical goals that were consistent with a 25 basis point increase in the Federal funds rate to 5 5/8 percent or somewhat higher.

Demand for excess reserves in the August 11 week was expected to be about \$75 million--extending the sawtooth pattern evident in the two previous weeks. The Desk estimated that a Federal funds rate average of 5 5/8 percent, or so, could lead to borrowing of about \$175 million. Thus, the Desk would have set an FR goal of -\$100 million but would have been willing to accept a deeper level, if possible, since that would bring NBR close to path.

RESERVE ESTIMATES: August 6 (Millions of dollars)

	<u>FR</u>	<u>ER</u>	<u>BR</u>
1. Path average	- 35	163	198
2. Average estimated on 7/23	+ 65	163	97
3. Average estimated on 7/30	+ 41	163	122
4. Average estimated on 8/6	+ 2	185	183
5. Cumulative amount estimated for the four-week interval	+ 8	740	732
6. Hypothetical level for week of 7/28**	- 30	70	100
7. Hypothetical level for week of 8/4	215	340	125
8. (6) + (7): cumulative hypothetical levels	+185	410	225
9. (5) - (8): cumulative amount estimated for remaining two weeks	-177	330	507
10. Hypothetical goal for 8/11 week*	-100	75	175
11. (9) - (10): level estimated for the final week	- 77	255	332

* affected by constraint on the Federal funds rate

** revised from earlier estimate

Developments in the August 11 week indicated that banks could have been willing to accumulate a small reserve deficiency rather than a surplus. It is estimated that borrowing would have averaged \$175 million and that ER could have been as low as -\$37 million. The Desk estimated that it could have attained FR and NBR that were about \$112 million below the hypothetical goals while Federal funds would have traded around 5 5/8 percent or a shade higher.

At the start of the August 18 week, estimates of required reserves were revised higher again so that to achieve the NBR path implied FR of -\$14 million for the four weeks on average. But, in fact, FR had hypothetically averaged slightly below this over the preceding three weeks so that achievement of the path implied FR in the final week of -\$8 million. On the other hand, bank demand for excess reserves was expected to rebound to about \$260 million. This would bring the average for the entire period to \$153 million, given the hypothetical ER values estimated for the preceding three weeks and subsequent revisions to them. The above estimates implied that borrowing would have to rise to near \$270 million in the final week if the NBR path was achieved, an amount that was higher than appeared consistent with the 5 3/4 percent ceiling on the Federal funds rate. If funds were to trade at the ceiling, it was estimated that banks would borrow \$200 million. Consequently, the hypothetical FR goal was set at \$60 million. If this were achieved, then, given the hypothetical levels estimated for the previous weeks, NBR would turn out \$17 million, on average, above path and within the allowable leeway.

RESERVE ESTIMATES: August 13 (Millions of dollars)

	<u>FR</u>	<u>ER</u>	<u>BR</u>
1. Path average	- 35	163	198
2. Average estimated on 7/23	+ 65	163	198
3. Average estimated on 7/30	+ 41	163	122
4. Average estimated on 8/6	+ 2	185	183
5. Average estimated on 8/13	- 14	153	167
6. Cumulative amount estimated for the four-week interval	- 56	612	668
7. Hypothetical level for week of 7/28**	- 24	76	100
8. Hypothetical level for week of 8/4**	188	313	125
9. Hypothetical level for week of 8/11	-212	- 37	175
10. (7) + (8) + (9): cumulative hypothetical levels for previous three weeks	- 48	352	400
11. (6) - (10): amount needed in final week to achieve NBR path for period	- 8	260	268
12. Hypothetical goal*	+ 60	260	200
13. $\frac{[(12) - (11)]}{4}$ expected average deviation from path, given constraint on the funds rate	+ 17		

* affected by constraint on the Federal funds rate

** revised from earlier estimates

Developments in the August 18 week suggest that bank demand for excess reserves would have been stronger than the \$260 million expected, so that to keep the Federal funds from rising above the ceiling, the Desk would have added more NBR than planned. It is estimated that ER would have been \$317 million and borrowing \$200 million, so that FR and NBR would have been \$57 million above the hypothetical goal.

	<u>FR</u>	<u>ER</u>	<u>BR</u>
1. Amount needed in Aug. 18 week to achieve NBR path for the four-week period	- 8	260	268
2. Hypothetical goal for August 18 week*	+ 60	260	200
3. Expected average deviation of NBR from path	+ 17		
4. Hypothetical level for August 18 week	+117	317	200
5. Actual average deviation of NBR from path	+ 31		

* affected by constraint on the Federal funds rate

At the conclusion of the interval, it appeared as if NBR would have turned out \$31 million, on average, above its path. The Federal funds rate would have risen quite steadily. The upward revisions in required reserves that began emerging in the second week of the intermeeting period would have strengthened this trend thereafter. While the four-week average of required reserves observed at the close of the period was above the one expected shortly after the period began, it was still slightly below the average expected at the time of the meeting--and incorporated in the path. The underlying reason for the increase in the funds rate was that the levels of member bank borrowing incorporated in the path could only have occurred at a funds rate that was above the discount rate.

Summaries of developments in other intermeeting periods:

March-April intermeeting period:

The NBR guide for this period incorporated required reserve levels that were estimated to be consistent with the midpoints of the ranges for the aggregates adopted by the FOMC,^{7/} with an allowance for excess reserves and borrowing consistent with the money market conditions prevailing at the time--with the Federal funds rate at 4 3/4 percent. The initial path level of free reserves showed an average of \$175 million for the five weeks.

Estimates of required reserves were generally above those incorporated in the path, but the extent of the strength was not entirely clear until the fourth week of the intermeeting period--when it appeared that the free reserve average consistent with the path was \$85 million. In addition, bank demand for excess reserves was proving to be stronger than anticipated, adding further to reserve demand for the five weeks as a whole and causing hypothetical levels to be above goals.

By the fourth week, it appeared that the constraints set for the Federal funds rate would have prevented the Desk from seeking NBR and FR levels that were low enough to achieve the path. The hypothetical goals for the final two weeks were set to be consistent with the upper constraint on the funds rate in order to minimize the emerging overshoot in NBR.

On balance, the hypothetical reserve levels estimated for the five weeks suggest that NBR would have averaged \$38 million

^{7/} In most cases, path required reserves were quite close to the amounts projected at the time of the FOMC meeting.

above path and that FR would have been \$128 million rather than the \$90 million needed to achieve the path--given the final estimates of required reserves. Actual NBR turned out \$91 million above path, with FR averaging \$181 million for the interval. Thus, to achieve an NBR average that was within \$50 million of the path, banks would have needed to reduce excess reserves or borrow more than they actually did. This suggests that the Federal funds rate would have risen over the period and the "hypothetical" estimate for the five weeks showed an average of 5.01 percent, compared to an actual average of 4.78 percent. As noted above, most of the increase in the funds rate would have emerged toward the end of the period and, at that time, it would have risen to its 5 1/4 percent upper constraint.

April-May intermeeting period:

The NBR path for this four week period was designed to be consistent with the aggregates specifications of alternative C in the April Blue Book. At the same time, the 4 1/2 to 5 1/4 percent range specified by the FOMC for the Federal funds rate was closer to the range suggested for alternative B, rather than to the 4 3/4 to 5 3/4 percent range viewed as consistent with alternative C. Thus, unless deposits (or required reserve ratios) had weakened significantly relative to expectations at the time of the meeting, it was likely that the specified upper constraint on the Federal funds rate would prevent the Desk from achieving the NBR path.

Shortly after the meeting, however, it appeared that achievement of the reserve path could be consistent with the Federal

funds rate remaining relatively unchanged or increasing by very little--say from around the 4 3/4 percent level then prevailing to around 4 7/8 percent. The new required reserve estimates suggested that the NBR path would be reached if FR turned out to be \$173 million, as opposed to the \$91 million path level of FR. But, later on, projections of required reserves were revised significantly higher to an average level above the one expected at the time of the meeting. FR--in the final estimates--had to average -\$128 million. It appeared that the implicit increase in member bank borrowing, if NBR were set at path average, would have caused the Federal funds rate to rise well above the 5 1/4 percent constraint--and possibly to as high as 6 percent.

In developing hypothetical FR and NBR targets over this period, the Desk also sought to take account of the Committee's explicit desire to see some rise in the Federal funds rate prior to the onset of the Treasury's quarterly refunding. The Desk sought to consider how operations might have been conditioned by securities markets developments. In view of the reaction in the markets to the money market firming that actually occurred in this interval, it might not have been possible, without disrupting the financing, to restrain reserve growth to a significantly greater extent and permit the funds rate to increase at a faster pace.

For the above reasons, hypothetical FR and NBR levels were set above those consistent with achieving the path and above those consistent with minimizing the overshoot in NBR. The sensitivity of the securities markets at that time and a significant underestimation of bank demand for excess reserves over the

period as a whole suggest that hypothetical NBR and FR levels would have been above the hypothetical goals.

NBR would have averaged \$253 million above path and FR would have been around \$125 million. Actual NBR turned out \$277 million above path and FR averaged \$149 million. Over the period, the Federal funds rate rose gradually from 4 3/4 percent and funds were trading around the 5 1/4 percent ceiling by the time of the May FOMC meeting. In the simulations, it is estimated that the Federal funds rate would have risen at a slightly faster pace and averaged somewhat higher than it actually did.

May-June intermeeting period:

The NBR path for this five-week period was similar to the one prepared in April in that the initial expectation for FR implied a rise in the Federal funds rate to a level that was higher than the ceiling specified by the FOMC, which was 5 3/4 percent. Required reserves were later revised downward, on balance, from expectations at the time of the meeting. While the behavior of required reserves would have ordinarily suggested that the NBR path could be achieved without violating the Federal funds rate ceiling, bank demand for excess reserves appeared stronger than anticipated and would, at times, have placed significant upward pressure on the Federal funds rate if operations had been geared toward achieving the path. Actual NBR turned out \$57 million above path, while the hypothetical estimates suggest that this overshoot could have been held to about \$30 million. (Near the end of this period, the Desk learned about a \$100 million downward revision to an earlier weekly reserve level and this helped bring the NBR average closer

to the path.) The Federal funds rate actually averaged 5.49 percent compared to the simulated estimate of 5.65 percent. Weekly hypothetical estimates for this interval suggest that money market conditions would have shown greater variation than they actually did, with the funds rate rising by the second week, retreating in the third and then rising again. This reflected week to week changes in the estimates of required reserves for the whole interval, which significantly affected the trends in free reserves that the Desk would have sought.

June-July intermeeting period:

Achievement of the NBR path for this four-week period at first seemed consistent with little change in money market conditions. While required reserves were later revised downward, bank demand for excess reserves again turned out stronger than expected. Indeed, it appeared that an uncompromising pursuit of the NBR path would have produced a Federal funds rate of $5 \frac{3}{4}$ percent in some weeks--the upper constraint specified by the FOMC. In this period, the Desk assumed that its operations would have been conditioned by evidence of weakness in the monetary aggregates. Specifically, the enlarged demand for excess reserves would have been partially accommodated and NBR would have turned out \$34 million above path. Still, reserve provision would have been less accommodative than it was since actual NBR turned out \$97 million above path, on average. The hypothetical funds rate was around $5 \frac{1}{2}$ to $5 \frac{5}{8}$ percent, in comparison to the decline from $5 \frac{1}{2}$ to $5 \frac{1}{4}$ percent that was actually sought over the period.

August-September intermeeting period:

The nonborrowed reserve path for this four-week period was expected to be consistent with little change in money market conditions. Required reserves were initially expected to be above path but were later revised downward substantially. Operating to achieve the NBR path would have caused the money market to firm initially but then to ease, with these tendencies enlarged at times by unanticipated variation in bank demand for excess reserves. In fact, because the Desk initially would have sought the wrong "trend" in FR, the lower constraint on the Federal funds rate would have prevented it, in the final week, from bringing FR and NBR as high as needed to achieve the path. Hypothetical NBR turned out \$61 million above path. Actual NBR, however, was only \$23 million less than path.

Sheila Tschinkel
October 13, 1976

BOARD OF GOVERNORS
OF THE
FEDERAL RESERVE SYSTEM

Office Correspondence

Date October 18, 1976

To Subcommittee on the Directive

Subject: Aggregate Reserves and

From Darwin Beck and John Paulus

Money Stock Relationships

Since the April 1976 FOMC meeting the Board staff has provided the FOMC and the Trading Desk with projections of average levels of aggregate reserve measures thought to be consistent with the midpoints of the short-run ranges for the monetary aggregates adopted at each FOMC meeting. These aggregate reserve projections were based on projected multiplier relationships between monetary and reserve aggregates. This report reviews the relationships between the actual multipliers and those projected by the staff, and offers some explanation for the differences that have been observed during the last five intermeeting periods. In addition, an attempt is made to estimate how much the multiplier relationships would have changed if the Desk had actually achieved the aggregate reserve targets.

I. BEHAVIOR OF M_1 AND M_2 RESERVE MULTIPLIERS

Tables 1 and 2 show expected and actual M_1 and M_2 multipliers for nonborrowed reserves, total reserves, and the monetary base.^{1/} The multipliers in the first two columns of these tables are based on current reserves and M_1 and M_2 lagged two weeks, while columns on the right side show the multiplier relationships between current reserves and current monetary aggregates.

^{1/} "Actual" multipliers are based on the money stock and reserves data available just prior to each FOMC meeting, since this is the information the FOMC would have had to make its decision on. The conclusions of our analysis are changed very little if final multipliers are used.

Table 1

COMPARISON OF EXPECTED AND ACTUAL M_1 MULTIPLIERS

<u>Intermeeting period</u>	<u>Lagged Deposits</u> ^{1/}			<u>Unlagged Deposits</u>		
	<u>Expected</u>	<u>Actual</u> ^{2/}	<u>Difference</u>	<u>Expected</u>	<u>Actual</u> ^{2/}	<u>Difference</u>
	Nonborrowed Reserves					
April 28 to May 19	8.865	8.879	.014	8.874	8.900	.026
May 26 to June 23	8.958	8.926	-.032	8.958	8.923	-.034
June 30 to July 21	8.859	8.798	-.061	8.891	8.813	-.078
July 28 to August 18	8.885	8.880	-.005	8.906	8.885	-.021
August 25 to September 22	8.918	8.916	-.002	8.942	8.930	-.012
Average absolute difference			.023			.034
	Total Reserves					
April 28 to May 19	8.845	8.865	.020	8.854	8.886	.032
May 26 to June 23	8.886	8.894	.008	8.886	8.891	.005
June 30 to July 21	8.816	8.764	-.052	8.848	8.778	-.070
July 28 to August 18	8.835	8.847	.012	8.855	8.852	-.003
August 25 to September 22	8.891	8.898	.007	8.914	8.912	-.002
Average absolute difference			.020			.022
	Monetary Base					
April 28 to May 19	2.653	2.662	.009	2.656	2.668	.012
May 26 to June 23	2.652	2.654	.002	2.652	2.653	.001
June 30 to July 21	2.639	2.632	-.007	2.649	2.637	-.012
July 28 to August 18	2.640	2.644	.004	2.646	2.645	-.001
August 25 to September 22	2.640	2.637	-.003	2.647	2.641	-.006
Average absolute difference			.005			.006

^{1/} Based on current reserves and M_1 lagged two weeks.

^{2/} As available the last week of the intermeeting period.

Table 2

COMPARISON OF EXPECTED AND ACTUAL M₂ MULTIPLIERS

<u>Intermeeting period</u>	<u>Lagged Deposits</u> ^{1/}			<u>Unlagged Deposits</u>		
	<u>Expected</u>	<u>Actual</u> ^{2/}	<u>Difference</u>	<u>Expected</u>	<u>Actual</u> ^{2/}	<u>Difference</u>
	Nonborrowed Reserves					
April 28 to May 19	20.312	20.254	-.058	20.374	20.325	-.049
May 26 to June 23	20.576	20.536	-.040	20.605	20.580	-.025
June 30 to July 21	20.469	20.385	-.084	20.534	20.451	-.082
July 28 to August 18	20.600	20.622	.022	20.670	20.674	.004
August 25 to September 22	20.779	20.815	.036	20.860	20.906	.046
Average absolute difference			.048			.041
	Total Reserves					
April 28 to May 19	20.266	20.222	-.044	20.327	20.292	-.035
May 26 to June 23	20.410	20.461	.051	20.440	20.506	.066
June 30 to July 21	20.370	20.304	-.066	20.434	20.371	-.063
July 28 to August 18	20.482	20.546	.064	20.552	20.598	.046
August 25 to September 22	20.714	20.774	.060	20.795	20.864	.069
Average absolute difference			.057			.056
	Monetary Base					
April 28 to May 19	6.079	6.072	-.007	6.097	6.093	-.004
May 26 to June 23	6.091	6.105	.014	6.099	6.118	.019
June 30 to July 21	6.098	6.099	.001	6.117	6.119	.002
July 28 to August 18	6.121	6.139	.018	6.142	6.155	.013
August 25 to September 22	6.151	6.156	.005	6.175	6.183	.008
Average absolute difference			.009			.009

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^{1/} Based on current reserves and M₂ lagged two weeks.
^{2/} As available the last week of the intermeeting period.

As can be seen from Table 1, the average absolute miss in the lagged M_1 -nonborrowed reserves multiplier was .023 over the period of the experiment. Each .01 change in the multiplier is equal to about \$350 million in M_1 . Thus, the average absolute difference in the level of M_1 due to a miss in the estimation of the multiplier relationship between M_1 and nonborrowed reserves was about \$800 million. This \$800 million miss is equal to about a 3 percentage point miss in monthly average M_1 growth at an annual rate. For total reserves, the average absolute miss in the multiplier was a bit smaller, .020, and the difference in the level of M_1 due to this factor averaged about \$700 million. For the monetary base the average absolute difference was .005, which is equal to about \$600 million in M_1 or roughly $2\frac{1}{2}$ percentage points at an annual growth rate.

The lagged M_2 multipliers are shown in the left half of Table 2. The average absolute misses in the M_2 multipliers were generally about twice the M_1 multiplier misses. Since each .01 miss in the M_2 reserve multiplier also reflects about \$350 million in M_2 deposits, the average absolute misses in M_2 associated with misses in the nonborrowed and total reserves multipliers were about \$1.7 and \$2.0 billion, respectively. These differences are equal to about 3 to $3\frac{1}{2}$ percentage points on monthly M_2 growth at an annual rate. The impact of misses in the monetary base multiplier was only slightly smaller, about $2\frac{1}{2}$ percentage points at an annual rate.

In order to determine if multiplier relationships between current aggregate reserves and current monetary aggregate measures were easier to predict than those based on lagged monetary aggregates, multipliers were calculated based on unlagged M_1 and M_2 . These "current" multiplier relationships are shown in the right half of Tables 1 and 2 for M_1 and M_2 , respectively. As can be seen from the tables, the average absolute differences are about the same using lagged or unlagged M_1 and M_2 .

II. SOME PROBLEMS IN PROJECTING MULTIPLIERS

Differences in the projected and actual multiplier relationships can arise from several sources. The distribution of reservable deposits and nonreservable deposits and variations in currency, which of course is nonreservable, can raise or lower the multiplier relationships. Given the current progressive structure of reserve requirements, the distribution of reservable deposits among large and small banks will also have an impact on the multiplier. For example, if M_1 increases about as expected, but a larger than expected portion of the deposit growth is at large banks which have higher reserve requirements, the multiplier relationships between reserves and M_1 will be smaller. In addition, if M_2 grows about as expected, but an unexpected large part of the growth occurs in the time deposit component, on which reserve requirements are lower, the multiplier will increase. The mix of time deposits between long and short-term maturities can also effect the multiplier relationships. As banks shift from short-term to longer-term time

deposit maturities, the average reserve ratio against time deposits will decline. Because the current structure of reserve requirements against time deposits was implemented less than a year ago, and no clear pattern for the average time deposit ratio has emerged in this short period, the staff has experienced difficulty in forecasting required reserves against time deposits. If the present structure of reserve requirements against time deposits is not changed, this source of error might be reduced in the future as shifts in time deposit maturities become more predictable.^{2/}

An additional source of error in the multiplier relationships stems from misestimation of excess reserves and borrowings. This is particularly true for the nonborrowed reserve multipliers. Nonborrowed reserves are defined as total reserves less borrowings from the Federal Reserve, or equivalently, as required reserves plus free reserves (excess reserves less borrowings).^{3/} Even if the deposits and required reserve relationships are properly specified the nonborrowed multipliers may be incorrect because the level of borrowing from the Fed or the amount of excess reserves held by banks may be different than expected--i.e., the estimate of free reserves may be incorrect. Over the past five intermeeting periods the staff estimates of free reserves were too low in every period, reflecting in part the emergence of Federal funds rates that were lower than those upon which the estimates of free reserves were based.

^{2/} Unpredicted movements in nonmonetary reservable deposits, such as government deposits, and nondeposit sources of funds, such as Euro-dollar borrowings, can also disturb the multiplier.

^{3/} With nonborrowed reserves defined as $NR = TR - B$ (where NR = nonborrowed reserves, TR = total reserves, and B = borrowings), and with total reserve equal to $TR = RR + ER$ (where RR and ER = required reserves and excess reserves, respectively), substitution of the latter identity into the former yields $NR = RR + ER - B$. Thus, nonborrowed reserves are equal to required reserves plus free reserves--the difference between excess reserves and borrowings.

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Demand for borrowed reserves is in large part a function of the Federal funds rate and projections of borrowings were based on an assumed Federal funds rate pattern. Table 3 shows the staff's assumed Federal funds rate range thought consistent with the short-run growth rates adopted for the aggregates by the FOMC, the FOMC's adopted Federal funds rate range, and the actual average Federal funds rate that prevailed during between-meeting periods. In general, the Federal funds rate ranges adopted by the Committee were lower than those the staff thought to be consistent with the monetary aggregate targets and the level of borrowings believed consistent with those aggregate growth rates. More importantly, the actual Federal funds rate that prevailed during the period was generally 25 to 50 basis points below the midpoint of the ranges thought consistent with the staff's projection of borrowed reserves. Thus, it is not surprising that the average level of borrowed reserves during the intermeeting periods was from \$25 to \$150 million below the level projected.

Another problem in estimating free reserves concerns the volatility of excess reserves. During the last five months, bank holdings of excess reserves ranged from a low of -\$180 million to a high of \$571 million. While the staff was generally able to predict the direction of the week-to-week change in excess reserves, sizable misses were recorded in projecting average levels for the five intermeeting periods. Over this period, excess reserves were projected to average \$182 million, about \$30 million below the actual average of \$210 million.

Table 3

COMPARISON OF EXPECTED AND ACTUAL
FEDERAL FUNDS RATES

<u>Between- meeting period</u>	<u>Federal funds rate range assumed consistent with aggregate reserve projections</u>	<u>Adopted Federal funds rate range</u>	<u>Actual average Federal funds rate</u>
April 28 to May 19	4½ to 5½	4½ to 5½	5.06
May 26 to June 23	5½ to 6½	5 to 5½	5.49
June 30 to July 21	5½ to 6½	5½ to 5¾	5.38
July 28 to August 28	5½ to 6½	4¾ to 5¾	5.30
August 25 to September 22	4¾ to 5¾	5 to 5½	5.25

These problems are summarized in Table 4, where period-by-period differences between actual and projected reserve measures are shown, together with the sources of these differences. The aggregate reserve measure with the smallest average absolute difference over the period of the experiment was total reserves (\$87 million). The average absolute difference for the nonborrowed reserve measure was only slightly larger (\$94 million) while the average difference for the monetary base was much larger (\$240 million). Notice that nonborrowed reserves tended to run above targeted levels in four of the five intermeeting periods, reflecting a consistent overestimation of free reserves.

In general, the differences between actual and projected aggregate reserve measures declined from period to period. In part this may reflect some improvement in the staff's ability to project aggregate reserve measures. However, any apparent improvement, based as it is on only five observation periods, may be nothing more than random variation in the series. A much larger number of observations will be required before any improvement in the projections can be established.

III. IMPLICATIONS OF ACHIEVING AGGREGATE RESERVES TARGET

Had the Desk actually been operating on an aggregate reserves target, and had that target been achieved, the pattern of interest rates and monetary growth would, of course, have been different from that which prevailed. In this section, we consider some possible

Table 4

DIFFERENCES BETWEEN ACTUAL AND TARGETED RESERVE AGGREGATE MEASURES ^{1/}
(Millions of dollars, seasonally adjusted)

	April 28 to May 19	May 26 to June 22	June 30 to July 21	July 28 to August 18	August 25 to September 22	Average Absolute Difference
1. (2 + 8) Nonborrowed reserves	250	75	89	45	-12	94
2. (3+4+5+ 6+7) Required reserves	199	-109	-59	-25	-103	99
	Difference due to level of deposits:					
3. Demand	365	-77	-91	78	-39	130
4. Time	-79	-3	10	-38	7	27
	Difference due to mix of deposits:					
5. Demand	18	-37	34	17	-54	32
6. Time	-96	27	14	-62	10	42
7. Other ^{2/}	-9	-19	-26	-20	-27	20
8. (9 - 10) Free reserves	51	184	149	71	91	109
9. Excess	27	32	117	1	51	46
10. Borrowings	-24	-152	-32	-70	-40	64
11. (2 + 9) Total reserves	226	-77	58	-24	-51	87
12. Currency	410	-162	-254	-37	118	196
13. (11+12) Monetary base	636	-239	-196	-61	67	240

^{1/} Actual data are as available just prior to each FOMC meeting.

^{2/} Reflects differences in required reserves held against nondeposit funds and differences due to rounding.

effects on interest rates and the monetary aggregates of the achievement of a nonborrowed reserves target. It would be especially desirable to derive the implications of pursuing a nonborrowed reserves target over a period of several months--i.e., to consider the cumulative effects on interest rates and the aggregates of achieving a reserves target over such a period. However, such an analysis cannot be performed because the decisions of the FOMC are based on conditions that prevail at the time of each meeting, and not on what would have prevailed had a different target been achieved. We have therefore considered each intermeeting period separately, as though an aggregate reserves target was adopted for that period alone.

For each intermeeting period, we have assumed that the Desk operated to hit the nonborrowed reserves target consistent with the monetary aggregates growth range chosen by the FOMC. If that target was above the actual level of nonborrowed reserves for that period, we attempted to estimate the effect on the monetary aggregates and the Federal funds rate of raising nonborrowed reserves until they were just equal to the targeted level. Conversely, if the target was below actual nonborrowed reserves, we estimated the effects of draining reserves in that period until the target was reached.

Efforts to lower nonborrowed reserves will require that free reserves be lowered, since required reserves are fixed over the first half of the intermeeting period (due to lagged reserve accounting), and are probably not very responsive to Desk actions over the second

half. In order for free reserves to decline, the Federal funds rate will have to be pushed up by the Desk. This, in turn should marginally reduce the public's holdings of deposits as market interest rates increase in concert with the funds rate.

To produce rough estimates of the effects on the funds rate and the monetary aggregates of Desk actions to hit the successive non-borrowed reserves targets, we assumed that a \$100 million change in free reserves was associated with about a 70 basis point change in the Federal funds rate, given the constant discount rate over the period. This assumption was based both on econometric work by Board staff^{4/} and conversations with Board and Trading Desk staff knowledgeable about these relationships.^{5/} Then, the change in the Federal funds rate was used to estimate the impact on M_1 and M_2 growth through staff judgments and relationships derived from the Board's monthly money market model.

The estimated impact on free reserves, Federal funds rate and monetary aggregates suggested by this exercise are presented period by period in Table 5. The results shown, it should be noted, assume no constraint on the Federal funds rate. Even though the largest difference between an actual and estimated Federal funds rate for an intermeeting period is 1 $\frac{3}{4}$ percentage points, the daily and weekly variation within the period could be much greater.

^{4/} See memo from Econometric and Computer Applications Section (R. Porter, D. Lindsay, and D. Laufenberg) to John Kalchbrenner, "Estimation and Simulation of Simple Equation Relating Reserve Aggregates and Monetary Aggregates," September 24, 1975 (esp. p. 38).

^{5/} It should be noted that no one believes that a linear relationship exists between the Federal funds rate and free reserves. We do not, however, believe we are introducing a significant bias in the analysis by making this assumption.

Table 5

IMPACT OF ACHIEVING NONBORROWED RESERVES
 TARGET ON VARIOUS FINANCIAL VARIABLES
 (Differences from actual levels or growth rates)

	Free reserves (\$ million)	Federal funds rate (% pts)	M ₁		M ₂		Impact on achieving ^{1/} money stock targets	
			(\$ million)	(% annual growth rate)	(\$ million)	(% annual growth rate)	(\$ million)	(% annual growth rate)
April 28 to May 19	-250	+1 $\frac{3}{4}$	-275	-975	-1.1	-1.7	275	975
May 26 to June 23	-75	+1/2	-75	-300	-.3	-.5	-75	300
June 30 to July 21	-89	+5/8	-100	-350	-.4	-.6	-100	-350
July 27 to August 18	-45	+3/8	-50	-175	-.2	-.3	-50	175
August 25 to September 22	12	-1/8	neg	neg	neg	neg	neg	neg

NOTE: Since impacts for each period shown in the tables were estimated separately, the changes shown cannot be cumulated.

neg--negligible (less than \$50 million)

^{1/} Positive figures indicate hypothetical monetary aggregate--that which would have been hit had nonborrowed target been achieved--closer to target than actual by amount shown. Negative figures indicate actual aggregates closer to target than hypothetical.

The estimated effects on financial variables shown in Table 5 also assumes that the nonborrowed reserve target would be hit exactly--there is no adjustment for a plus or minus \$50 million deviation. If such an adjustment were made, the Desk was on target in two out of the five periods and in two other periods was so close to target that actual achievement of the targets would have had little effect on the Federal funds rate or monetary aggregates.

As can be seen from Table 5, except for the April 28 to May 19 period, the estimated effects of achieving the nonborrowed reserves target on M_1 and M_2 growth rates were rather small. On balance, M_1 control was essentially unchanged, with a sizable improvement in the first intermeeting period being offset by smaller misses in subsequent periods. M_2 control, however, was improved in most periods, with the largest improvement also coming in the first intermeeting period. As indicated earlier, achievement of the nonborrowed reserve target over a series of intermeeting periods could and likely would have resulted in larger impacts on M_1 and M_2 growth rates.

The results of the exercise summarized in Table 5 can be taken a step further. Using the estimated effects on M_1 and M_2 of achieving the nonborrowed reserves target, a new set of multipliers can be derived and compared with the targeted multipliers. Such a comparison should show whether achievement of the nonborrowed reserves target would reduce the differences between expected and "actual"--in this case hypothetical--multipliers. These calculations are shown in Table 6.

Table 6

Comparison of Average Absolute Differences Between
 Expected and Actual, and Expected and Hypothetical,
 M_1 and M_2 Nonborrowed Reserves Multiplier

	<u>Based on lagged money stock</u>	<u>Based on unlagged money stock</u>
Average absolute differences between:		
<u>M_1 multiplier:</u>		
Actual less expected	.023	.034
Hypothetical less expected	.028	.037
<u>M_2 multiplier:</u>		
Actual less expected	.048	.041
Hypothetical less expected	.038	.037

To derive the figures shown in the left half of Table 6 for the lagged multiplier relationship, actual M_1 and M_2 average levels were adjusted by only half of the estimated impact shown in columns 3 and 4 of Table 5. This was done because for roughly half the period the level of the money stock is already determined. For the unlagged figures shown in the right side of Table 6, M_1 and M_2 levels were adjusted by the full impact shown in Table 5.

As can be seen from Table 6, in two out of the four cases the multiplier, on average, would have been closer to targeted values if the nonborrowed reserves target had been achieved. Using the unlagged multipliers, the average absolute miss in M_1 would have been increased from about \$1.2 billion to \$1.3 billion, or a little less than $\frac{1}{2}$ of a percentage point at a monthly average annual rate. For M_2 on an unlagged basis, the reduction in the average absolute miss is only \$100 million or about .2 of a percentage point at a monthly average annual rate. Of course, with so few observations, it is unclear whether these differences are statistically significant.

A second comparison that can be derived from Table 5 is the hypothetical variation in the Federal funds rate. That is, treating each period separately, one can calculate the actual change in the funds rate for each period as well as the change in the funds rate that might have occurred if the nonborrowed reserve target had been achieved. Such a comparison is shown in Table 7.

Table 7

Comparison of Actual and Hypothetical Changes in the
Federal Funds Rate
(In percentage points)

<u>Intermeeting period ending</u>	<u>Change in actual Federal funds rate from previous period</u>	<u>Change in hypothetical Federal funds rate from previous period</u> ^{1/}
May 19	.28	2.03
June 23	.43	.93
July 21	-.11	.52
August 18	-.08	.30
September 22	-.05	.18
Average absolute change	.19	.79

^{1/} Actual change in Federal funds rate plus the change in the funds rate (shown in column 2 of Table 5) required to achieve targeted nonborrowed reserves.

As can be seen from Table 7, the period-to-period changes in the Federal funds rate would have been greater if the nonborrowed reserves target had been achieved and if there were no Federal funds rate constraint in operation during the five periods of comparison. These changes could be moderated somewhat by assuming that achieving this target within a range of plus or minus \$50 million was acceptable.

IV. CONCLUDING REMARKS

The exercise we have described in Section III suggests that the achievement of a nonborrowed reserves target would have reduced the discrepancy between expected and actual M_2 multipliers, but would have increased the discrepancy between expected and actual M_1 multipliers slightly. On balance, M_1 control would have been essentially unchanged while M_2 control would have been improved somewhat. In order to achieve a nonborrowed reserves target the FOMC would have to permit greater variation in the Federal funds rate than has generally occurred in the past. However, we would emphasize that our estimates are based on single period comparisons, and are of limited value because they cannot be cumulated to produce estimated effects over longer periods of time. Moreover, the single period estimates themselves are very crude, and were presented mainly to indicate rough orders of magnitude.