

BOARD OF GOVERNORS
OF THE
FEDERAL RESERVE SYSTEM

STRICTLY CONFIDENTIAL (FR)
CLASS II - FOMC

Office Correspondence

Date July 1, 1987

To Federal Open Market Committee

Subject: Attached Study of Borrowing

From Donald L. Kohn

and the Federal Funds Rate

At the May FOMC meeting, the Committee requested a staff study of the relationship of discount window borrowing sought by the Federal Reserve under current operating procedures and the federal funds rate. The attached memorandum examines the variations in the federal funds rate around levels that were thought to be consistent with intended borrowing and the discount rate. The memorandum analyzes the uncertainties in the relation between the funds rate and borrowing and in achieving the intended level of borrowing that represent the underlying sources of unanticipated variations in the funds rate. Because the Committee's request arose in part from questions about developments over the previous intermeeting period, the Desk's analysis of the circumstances that produced substantially more borrowing than intended and a somewhat higher funds rate than expected over that period is attached as an appendix to the memorandum.

The memorandum concludes that current operating procedures provide a basic anchor to the federal funds rate. Over time, this rate is influenced primarily by the interaction of the amount of borrowing "forced" on the banking system by Desk operations with the willingness of depository institutions to use the discount window. This willingness in turn largely depends on the spread of the funds rate over the discount rate. To the extent that the Desk can achieve the intended level of borrowing and that the relationship between borrowing and the spread is stable, the funds rate will be reasonably predictable given the discount rate.

However, the evidence presented in the memorandum suggests there is considerable looseness in the relationship between intended borrowing and the federal funds rate, especially over the short-run. One source of this slippage is the relationship between actual borrowing and the federal funds rate. The federal funds rate associated with a given level of borrowing depends on a number of factors, including market expectations about current or future policy, other forces affecting money market conditions generally, the strategy of the Desk in meeting reserve objectives, unusual borrowing demands in special circumstances such as computer failures, and more general changes in the inclination of depository institutions to tap discount credit. Another source of unexpected variation in the funds rate arises from deviations of actual borrowing from intended levels owing to misses in projections of market factors supplying reserves and of demands for excess or required reserves, or temporary considerations inhibiting the Desk from achieving its nonborrowed reserve objective.

In practice, deviations of the funds rate from anticipated levels generally tend to be smaller than might be suggested by the statistical results viewed in isolation. This reflects in part the role of market expectations in confining movements in the funds rate even when borrowing departs substantially from intentions and in part the role of offsetting adjustments of the Desk's reserve provision in response to transitory shifts in the relation of borrowing to the spread. Even so, with the Desk pursuing a borrowing objective, the federal funds rate does depart from anticipated levels, sometimes noticeably in reflection of a variety of market forces. The capacity for such market forces to show through in the funds rate could be viewed as a desirable property of current procedures, to the extent it

conveys information about market conditions and on occasion allows the funds rate to begin moving more quickly than otherwise to levels later judged to be appropriate in the face of evolving economic conditions.

BOARD OF GOVERNORS
OF THE
FEDERAL RESERVE SYSTEMSTRICTLY CONFIDENTIAL (FR)
Class II FOMC**Office Correspondence**Date July 1, 1987To Donald KohnSubject: A Review of the Relation of theFrom David Lindsey & James GlassmanFunds Rate and Intended Discount Borrowing

At the last FOMC meeting, questions were raised about the current operating procedures in which reserve provision is geared to realizing a certain level of adjustment plus seasonal borrowing at the discount window ("pressures on reserve positions" in the parlance of the directive). The questions arose in part out of events during the previous intermeeting period, when borrowing had run substantially above the levels that were being sought, and the federal funds rate had risen somewhat above the area expected to be associated with the intended level of borrowing. An appendix to this memorandum gives the Desk's analysis of the particular circumstances in the previous intermeeting period that contributed to the outcomes for borrowing and, to an extent, the federal funds rate. The body of this memorandum discusses in more general terms the uncertainties both in the relationship of actual borrowing to the federal funds rate and in the process of attaining intended levels of borrowing. It also examines the interaction of these two sources of uncertainty in inducing movements of the funds rate away from levels that might be expected given the intended level of borrowing and the discount rate.

Background

Since late 1982, the FOMC has relied on the level of adjustment plus seasonal borrowing as the primary guide for open market operations. At each FOMC meeting, the Committee has agreed on the assumption for adjustment plus seasonal borrowing to be used by the Trading Desk in constructing the target path for nonborrowed reserves for the first reserve maintenance period after the meeting. The directive has indicated the conditions under which

intended pressures on reserve positions, as indexed by this average borrowing assumption, would be left the same or altered as the intermeeting period progresses.¹ The Desk keys its provision of nonborrowed reserves to achieving the assumed level of borrowings. The Desk routinely consults estimates of the demands for required and excess reserves, and derives the target path for nonborrowed reserves in each maintenance period by subtracting the borrowing assumption from the expected demand for total reserves. The purpose of this approach is to "force" the banking system to borrow the intended aggregate amount at the discount window. Although borrowing can vary considerably from the desired level in any particular maintenance period, over time these short-run deviations tend to average out.

The evidence suggests that the use of borrowing as an operating guide affords the FOMC through the Desk considerable influence over conditions in the federal funds market and to a lesser degree other money markets, while still enabling the funds rate to fluctuate in response to changes in market expectations of policy actions and other forces affecting money markets generally as well as to disturbances in the supply and demand for reserves. There is a systematic, if somewhat loose, association between the spread of the funds rate over the discount rate and the willingness of institutions to draw on adjustment plus seasonal borrowings. Because access to the discount window is viewed as a privilege, depository institutions are encouraged through administrative pressure to husband its use. But they can be induced to bear the implicit cost of administrative pressure along with the explicit cost of the discount rate by borrowing at the window so long as the interest

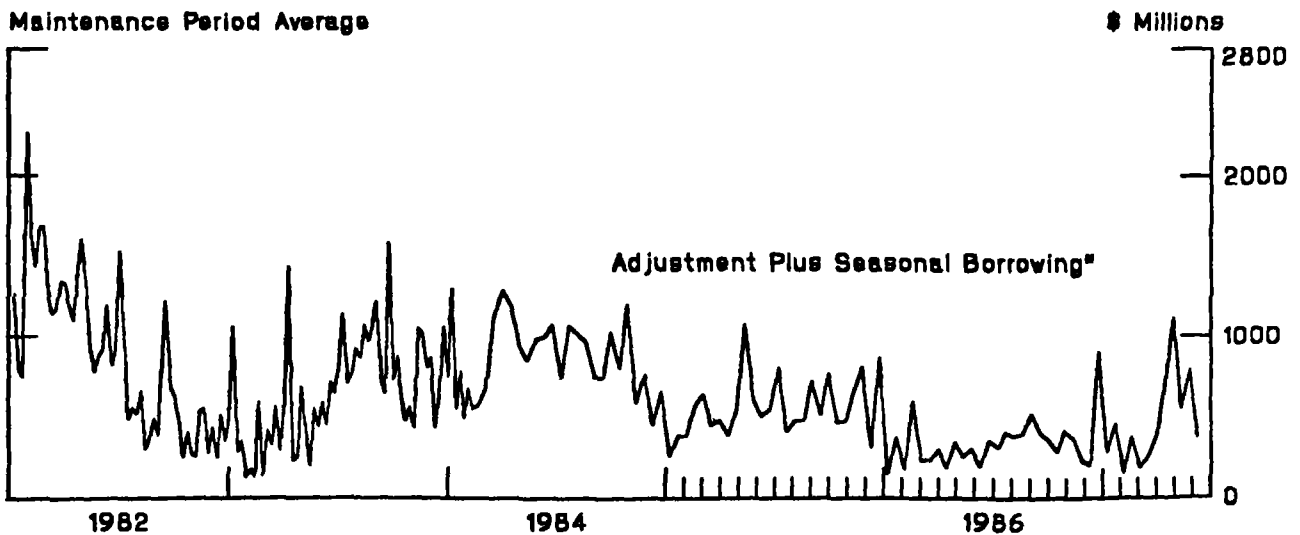
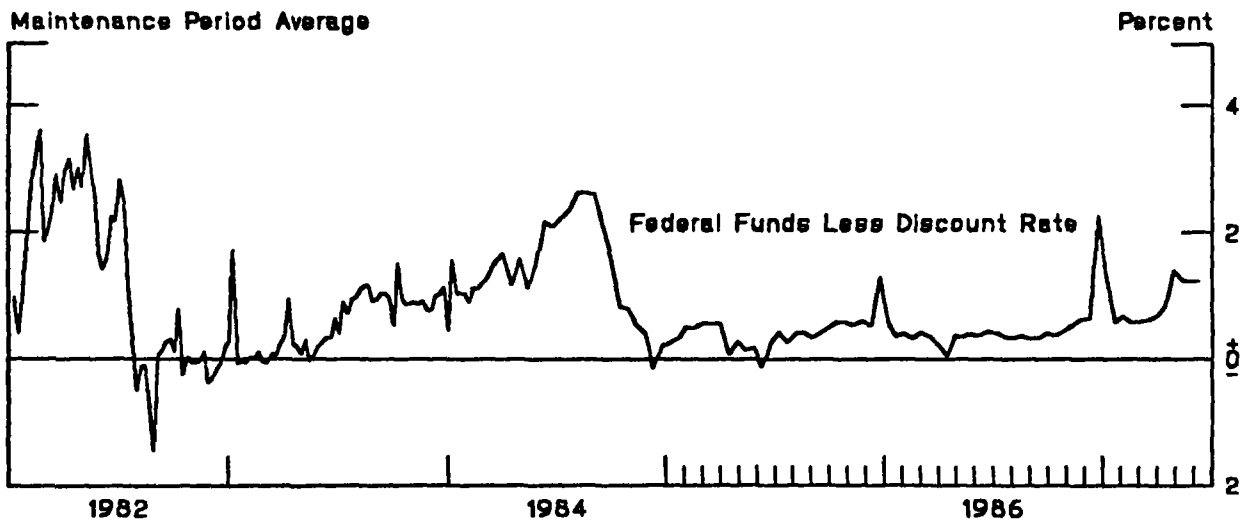
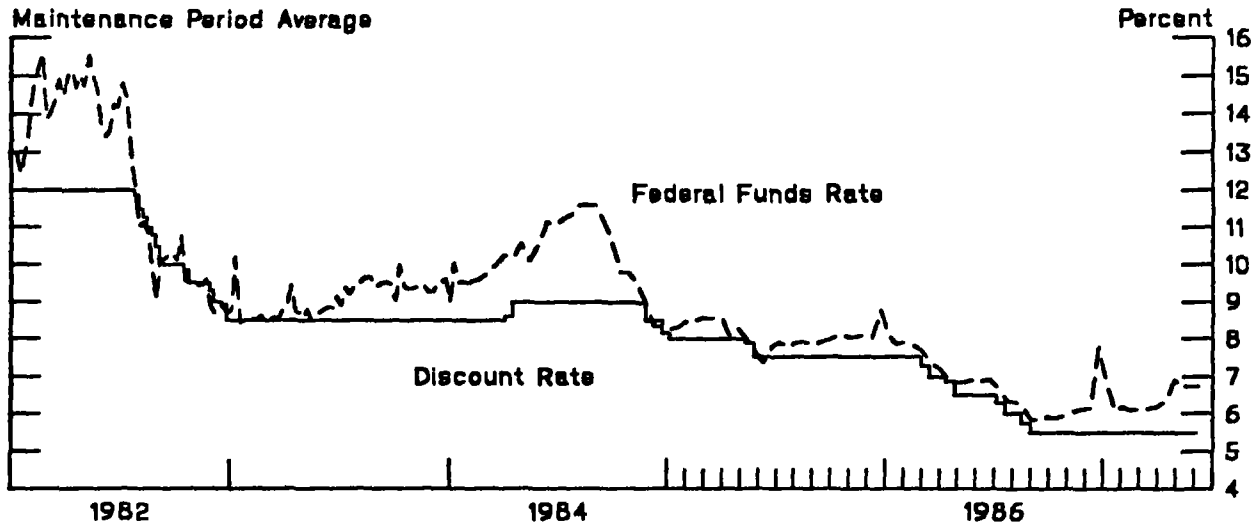
1. Neither the Directive nor the Policy Record expresses the borrowing assumption in quantitative terms, although the Annual Report of the Manager of the System Account, published by the Federal Reserve Bank of New York each spring, includes the borrowing assumption initially in effect over each intermeeting period during the previous calendar year.

cost of borrowing federal funds is viewed as even more expensive. Greater discount borrowing in the aggregate tends to be associated with a wider spread of the funds rate over the discount rate—which encourages more institutions to rely on the window more frequently and for larger amounts. This association between actual borrowing and the spread becomes increasingly evident as data are averaged over longer periods, but it is discernible in the maintenance period data shown in the lower two panels of chart 1. (Data in the chart are on a weekly basis before the introduction of contemporaneous reserve accounting in early February 1984 and bi-weekly thereafter.)

Although a borrowing guide provides an anchoring mechanism that generally acts to confine unexpected movements of the funds rate, upon occasion the two-week average funds rate can vary significantly from the area expected to be typically associated with a given discount rate and given borrowing assumption. One reason for such variation in the funds rate is that the relation between the funds rate–discount rate spread and the actual level of borrowing is rather loose in practice, especially in the shorter run, as indicated in the lower two panels of chart 1.

This slippage is not altogether surprising given the thousands of institutions having access to the window with differing reserve management strategies and expectations of reserve market conditions, and the varying distribution of reserves across these institutions. Also, the spread associated with a given level of borrowing may depend on recent patterns of borrowing, given the way the discount window is administered; the more frequently an institution borrows at the window, the greater the administrative pressure

Chart 1

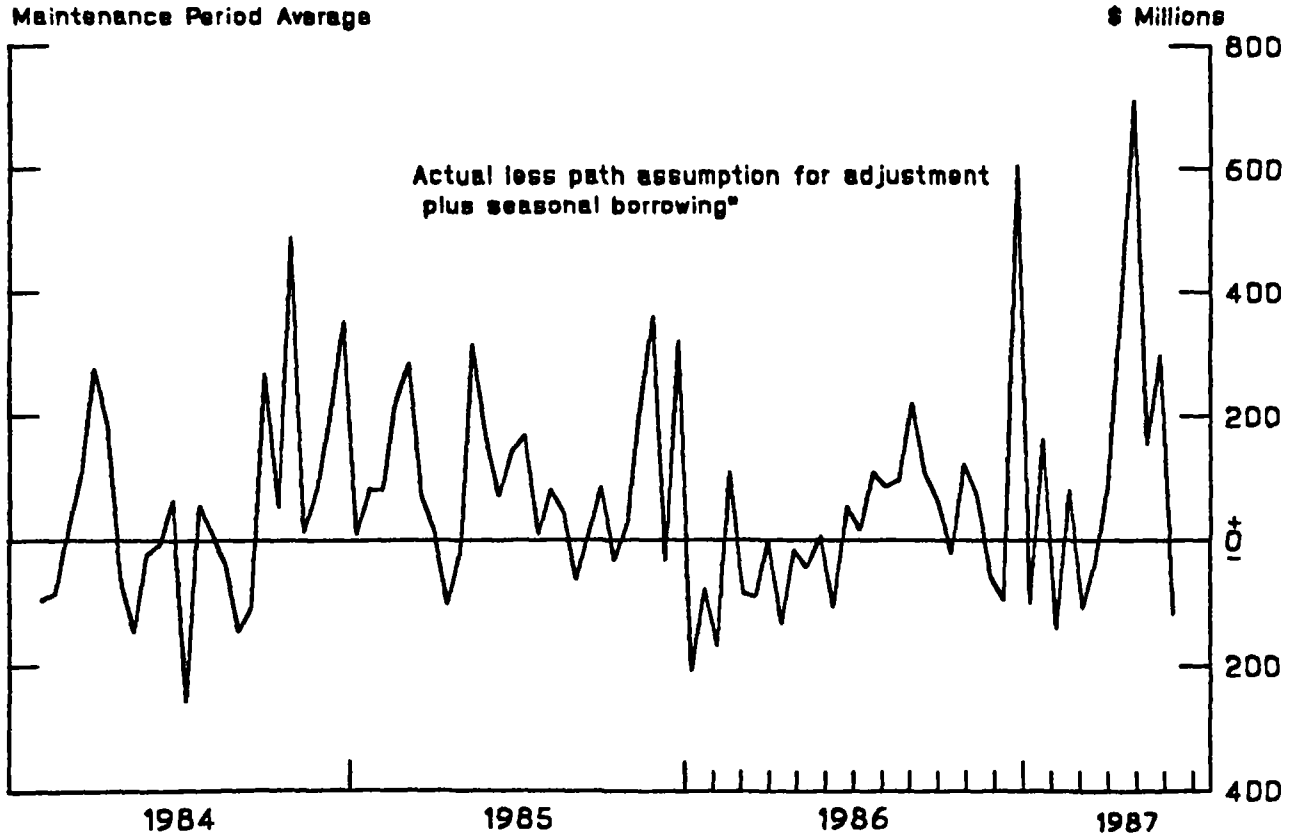
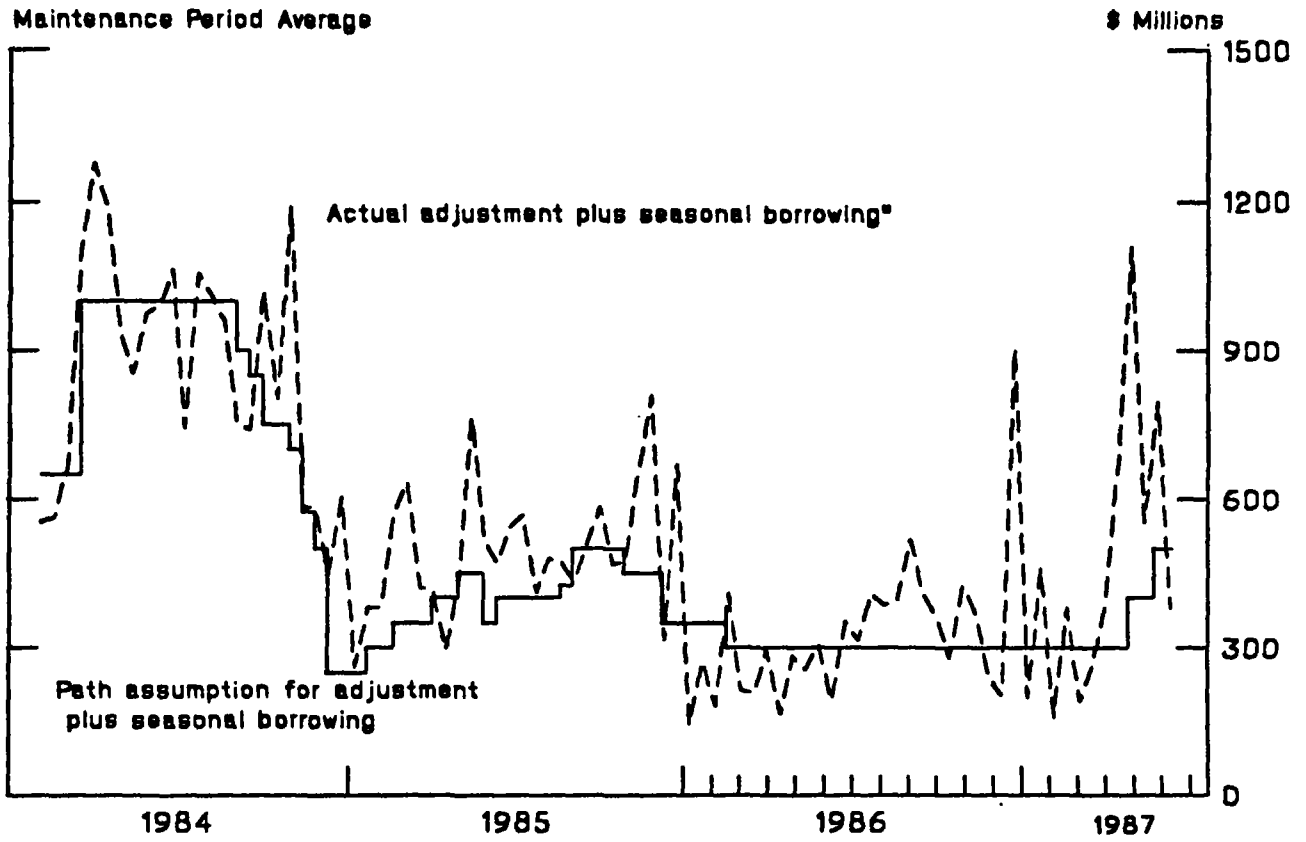


*Excludes special situation borrowing

that is applied, so that, for example, a sudden spike in borrowing may not be associated with as wide a spread as a persistently high borrowing level. Moreover, institutions' willingness to tap discount credit at a given spread may depend on the particular circumstances in markets. At times when markets become concerned about the stability of the banking system, institutions in general may become more wary of using the window for adjustment credit out of a desire to avoid any risk of public perceptions that they are experiencing liquidity difficulties. Such a reaction places added demands on the funds market and raises the funds rate relative to the discount rate for a given borrowing level. Changing expectations about current or prospective reserve market conditions also can play an independent role. For example, a shift in market sentiment to expectations of a near-term tightening of reserve pressures would tend to raise the federal funds rate as institutions conserve their borrowing access. Moreover, random events, such as computer breakdowns, can cause surges in borrowing that are basically unrelated to incentives captured by the funds rate-discount rate spread. The approach of the Desk to reserve operations also can affect the relationship of the spread to borrowing. Extra caution by the Desk in meeting reserve needs during most of the maintenance period can raise the period-average funds rate above the level typically associated with a given amount of borrowing, while unusually generous reserve provision early in the period might result in a lower spread than normal.

A second reason for unexpected movements in the funds rate relative to intended borrowing is that the actual two-week average level of borrowings at times can move substantially away from the borrowing assumption. Such deviations since early 1984 are shown in chart 2. They can stem from several sources. Even late in the reserve period, demands for required and excess

Chart 2



*Excludes special situation borrowing

reserves can be misforecast, as can market factors affecting nonborrowed reserves, such as the Treasury balance or float. Or borrowing early in the period can run unexpectedly high, making attainment of the average borrowing assumption a practical or even arithmetic impossibility even if reserve conditions turn easy late in the period. Alternatively, a shortage of collateral in the market for System RPs may mean a lack of acceptable offerings to accomplish the desired reserve injection, inducing an undesired rise in borrowing.

The next section of this paper examines econometric evidence on the relation of borrowing to the funds rate–discount rate spread, including such topics as the systematic response of the funds rate to a change in borrowings, sustained shifts in the relationship, and the shorter-run looseness of the relationship. The section after that then assesses the relative importance of some of the various influences behind divergences of actual borrowing from the path assumption. The final section addresses the extent to which the funds rate has differed from levels that might have been expected. It explains how variations in the willingness of institutions to borrow given the spread typically interact with misses of borrowing from the path assumption to mute unexpected variations in the funds rate.

The Relation Between Borrowing and the Spread of the Funds Rate over the Discount Rate

The behavior by individual reserve managers in response to the forces influencing their discount borrowing decisions is no doubt quite complex. Nevertheless, examining a relatively simple aggregate model of borrowing is useful as a benchmark, not only to quantify the influence of the most significant economic factors, but also to measure the remaining degree of unpredictability in borrowing.

The simplest model characterizes discount window borrowing as being determined by the spread of the federal funds rate over the discount rate, a constant term and a random error term:¹

$$\text{Borrowing} = \text{constant} + b (\text{federal funds rate} - \text{discount rate}) + \text{error}.$$

Econometric estimates of this simple borrowing model are summarized in table 1. The estimates are based on adjustment plus seasonal borrowing measured to exclude special situation borrowing.² The model was estimated in two ways using data for reserve maintenance periods from early 1982 through mid-1987. Estimate A in table 1 treats borrowed reserves as the dependent variable and the spread as the explanatory variable. Estimate B uses the spread as the dependent variable and borrowing as the explanatory variable. Both estimating procedures attempt to correct for biases caused by the

1. The spread variable is multiplied by a slope coefficient, b , representing the rise in borrowing (in millions) associated with a one percentage point rise in the spread. The inverse of b ($1/b$) times 100 represents the rise in the spread (in percentage points) associated with a \$100 million rise in borrowing. The constant or intercept in principle represents the amount of borrowing that would tend to occur even when the funds rate is the same as the discount rate. It differs in concept from the lower "frictional" or "minimal" level of borrowing that represents the typically unavoidable amount of borrowing that would occur on average even if the funds rate were well below the discount rate.

2. From time to time special circumstances may give a depository institution little choice but to borrow at the discount window. For example, the Bank of New York experienced computer problems on November 21, 1985, and was forced to borrow adjustment credit at the discount window to avoid overnight overdrafts of their reserve account. Problems of a more protracted nature were experienced by Continental Illinois beginning in early May 1984, but it was not until early June that its borrowing was reclassified from adjustment to extended credit. On those and other similar occasions, the Desk has made an allowance for such borrowing by viewing it at least informally as akin to extended credit. For purposes of meeting reserve objectives, the Desk treats extended credit borrowing as nonborrowed reserves. As with extended credit, less pressure often is exerted for prompt repayment of such special situation borrowing than is the case for adjustment credit.

Table 1

ESTIMATES OF THE BORROWING RELATIONSHIP¹

	Estimate A ²	Estimate B ³
<u>Whole period (1982 - mid-1987)</u>		
1. Rise in borrowing given a one percentage point rise in the spread	\$420 million	\$393 million
2. Rise in the spread given a \$100 million rise in borrowing (percentage points)	.24	.25
Standard errors:		
3. Borrowing	\$230 million	
4. Spread (percentage points)		.57
<u>1982 - 1985 (excluding summer of 1984)</u>		
5. Constant	\$365 million	\$388 million
Standard errors:		
6. Borrowing	\$248 million	
7. Spread (percentage points)		.62
<u>Summer of 1984⁴</u>		
8. Constant	-\$59 million	-\$5 million
Standard errors:		
9. Borrowing	\$200 million	
10. Spread (percentage points)		.49
<u>1986 - mid-1987</u>		
11. Constant	\$128 million	\$144 million
Standard errors:		
12. Borrowing	\$156 million	
13. Spread (percentage points)		.40

1. Both estimating procedures jointly use data from the maintenance period ending January 6, 1982 through the maintenance period ending June 3, 1987, accounting for two shifts in the constant term with dummy variables.
2. Borrowing is the dependent variable, using two-stage least squares.
3. The funds-discount rate spread is the dependent variable, using two-stage least squares.
4. Maintenance periods ending July 4, 1984 through September 26, 1984.

simultaneous determination of borrowing and the spread.¹ The models also allow the constant term to differ in three periods: 1982 through the end of 1985 excluding the summer of 1984, the summer of 1984, and the period since 1985.

The estimates shown in row 2 of table 1 imply that, on average over the last 5-1/2 years, a \$100 million increase in borrowing was associated with a 24 to 25 basis point increase in the funds rate spread over the discount rate. This estimate is virtually the same as the quarter point per \$100 million judgmental rule of thumb the staff has used for many years.

The constant term is estimated to have shifted considerably over several periods in the past 5-1/2 years.² From 1982 through 1985, excluding

1. Ordinary least squares estimates of the slopes of the models (not shown) are very sensitive to the way in which the model is estimated. For example, with the funds rate spread as the dependent variable, an increase in borrowing of \$100 million is estimated to be associated with a rise in the funds rate relative to the discount rate of 6 basis points. On the other hand, with borrowing as the dependent variable, a 31 basis point increase in the spread is associated with each \$100 million increment in borrowing. The divergent estimates for these two different forms of the equation reflect the strongly simultaneous interaction of borrowing and the federal funds rate, an inter-relationship that can impart serious biases to ordinary least squares estimates of the slope. In fact, employing econometric techniques to correct for such biases—involving instrumental variables in a first step to predict the explanatory variable—provides for similar conclusions with either form, as shown in table 1.

2. The constant term also may be influenced by seasonal variations but systematic seasonal effects on adjustment plus seasonal borrowing are difficult to pin down with econometric methods. Seasonal variation in discount window borrowing would induce shifts in borrowing for a given interest rate spread or conversely would result in greater or lesser pressure in the federal funds market for a given level of borrowing. However, the empirical evidence is somewhat ambiguous on this issue. Some seasonality seems to arise from the discount window program designed to accommodate the seasonal needs of banks, primarily reflecting demands associated with agricultural activity. When borrowing functions are estimated for seasonal borrowing alone, the summer months exhibit seasonal movements that are quite significant in a statistical sense, although relatively small in magnitude. Such month-to-month variations, up to around \$100 million, seem to be either offset by opposite movements in adjustment borrowing or swamped by random noise and thus difficult to detect in estimates of the aggregate borrowing function for both types of discount window credit together. Seasonal dummy variables are generally not significant in aggregate borrowing functions of the form summarized in table 1 when estimated since early 1982.

the summer of 1984, the estimated constant averaged in the \$365 to \$390 million area. (The "frictional" or "minimal" level of borrowing that typically would have emerged with the funds rate well below the discount rate probably was only \$150 to \$250 million). Chart 3 shows the scatter of points representing borrowing and the associated funds rate spread for the maintenance periods from 1982 through the end of 1985. The chart also plots the estimated average borrowing relationship over that period excluding the summer of 1984.¹

The summer of 1984 was notable because willingness to use the discount window dropped sharply for a given funds-discount rate spread. The estimates in table 1 and the scatter plot on chart 3 suggest that this can be represented by a substantial backward shift in the constant term. Financial markets became wary about the condition of large banks following the onset of funding difficulties by the Continental Illinois National Bank. Larger banks apparently shied away from the discount window to avoid any risk of rumors about their financial condition. In practice, this became apparent as the spread widened for the borrowing being sought, which remained constant over the summer. As Continental's funding problems were brought under control and the adverse publicity about the condition of large banks faded, borrowing and the rate spread moved into more normal alignment.

The estimated constant term for 1986 to the present suggests a downward shift in borrowing for any given spread on the order of \$200 to \$250 million early in 1986, implying a constant term around \$125 to \$150 million. The lower value for the constant seems to have continued to the present. This shift is apparent in chart 4, which presents maintenance-period

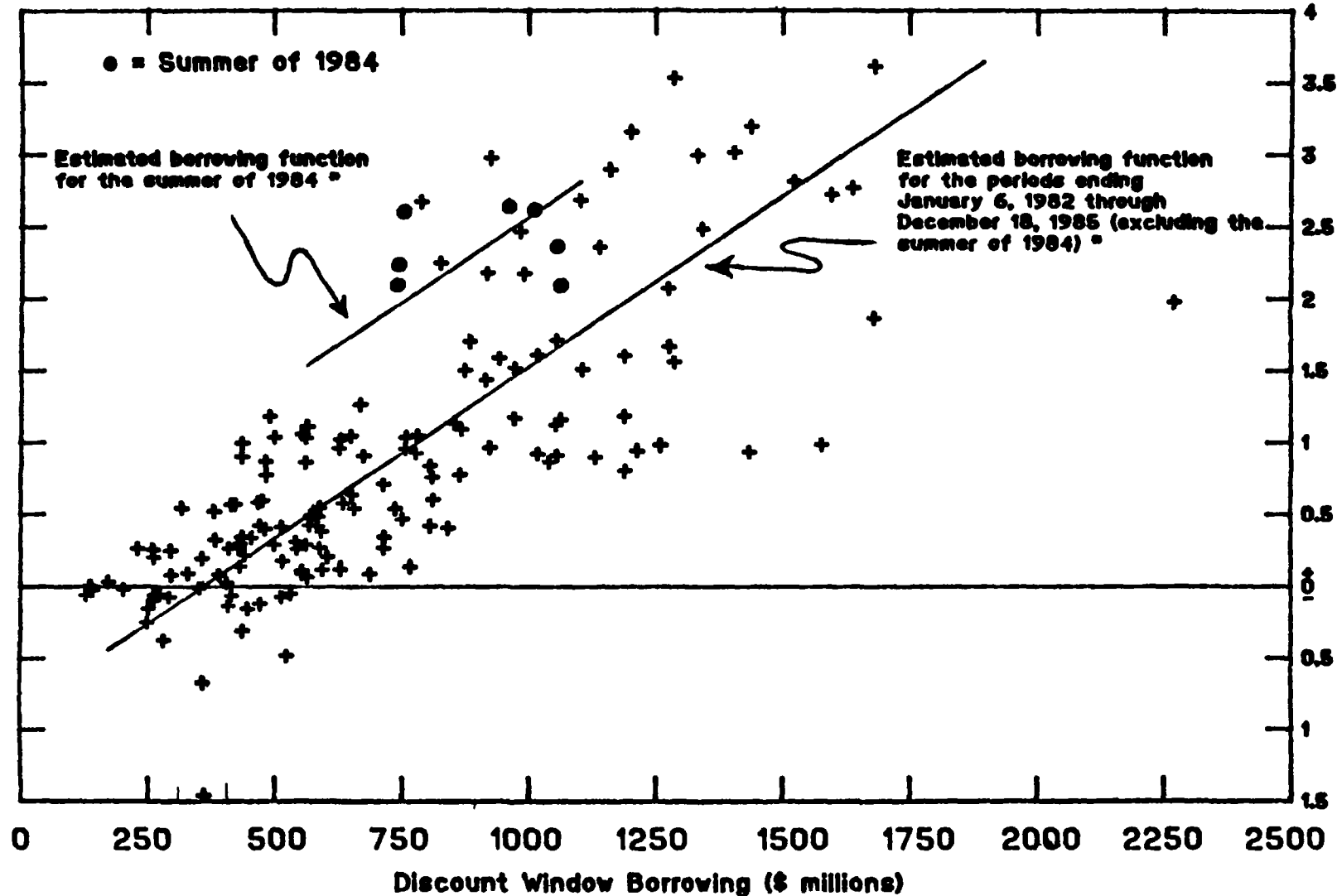
1. The lines shown are from estimate A, using borrowing as the dependent variable.

Chart 3

The Relationship Between Borrowing and the Funds Rate Spread (January 6, 1982 through December 18, 1985)

Maintenance Period Average

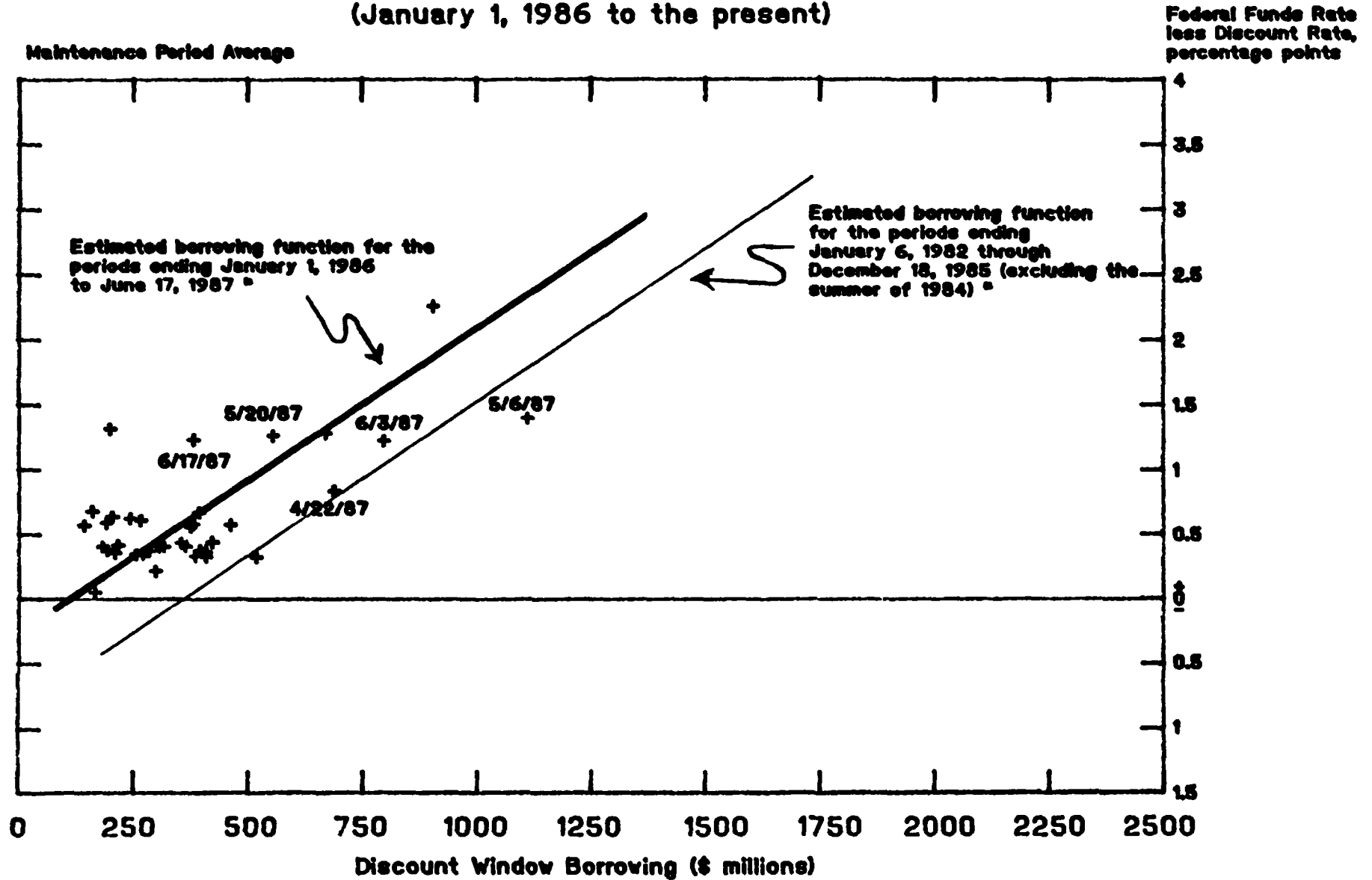
Federal Funds Rate
less Discount Rate,
percentage points



*Borrowing functions jointly use data from the maintenance period ending January 6, 1982 through the period ending June 3, 1987, allowing for two shifts in the constant term.

Chart 4

The Relationship Between Borrowing and the Funds Rate Spread (January 1, 1986 to the present)



*Borrowing functions jointly use data from the maintenance period ending January 6, 1982 through the period ending June 3, 1987, allowing for two shifts in the constant term.

data since early 1986.¹ The estimated borrowing relationship for the bulk of the period from 1982 through 1985 is repeated as a reference.

The reasons for the shift in borrowing since 1985 are not completely understood. Nevertheless, table 2, which focuses on borrowing behavior by broad size groupings of depository institutions, provides some insight into the shift. As the table shows, the estimated constant term for small banks (assets less than \$1 billion) has fallen \$145 million, and accounts for most of the absolute shift, although the estimated constant for large banks also moved somewhat lower and by a bigger percentage than that for smaller banks. The anecdotal evidence suggests that small banks, finding themselves with much more liquidity than had been usual in the last ten years, have experienced on balance fewer circumstances that would give rise to borrowing. More reluctance on the part of medium- and large-sized banks may have resulted from sensitivity to growing public concern about the financial soundness of a number of these institutions.²

Table 1 also shows the remaining degree of uncertainty about the borrowing relationship after the simple model takes account of sustained shifts in the constant term and variations in the spread. The standard error covering the whole period since 1982 reported for borrowing in row 3 implies that, given the spread, actual borrowing was within plus or minus \$230 million of the model's prediction two-thirds of the time. The comparable statistic in row 4 for the prediction of the federal funds-discount rate spread, given actual

1. A plot of equation errors without allowing for this downward shift in the constant term shows a clear once-and-for-all drop in the average error to negative values in early 1986. When a dummy variable is used for the last year and a half, it is highly statistically significant.

2. The introduction of voluntary caps to limit intraday overdrafts in March of 1986 does not seem likely to have measurably reduced the need for overnight credit accommodation at the discount window, given the relatively small number of institutions that seem to have been affected by the current caps.

Table 2

ESTIMATES OF THE CONSTANT TERM BY SIZE OF DEPOSITORY INSTITUTIONS¹

	Pre-1986 excluding Summer 1984	Summer 1984	Last year-and-a-half
	Feb. 15, 1984 - Dec 18, 1985	July 4-Sept 26	Jan. 1, 1986-June 3, 1987
Banks with assets less than \$1 billion	268	202	123
Banks with assets between \$1 and \$3 billion	48	-15	28
Banks with assets greater than \$3 billion	105	-197	30

1. Estimated with ordinary least squares using borrowing by size class of depository institution as the dependent variable. The estimates jointly use data from the maintenance period ending February 15, 1984 to the period ending June 3, 1987, with dummy variables for the time spans in the last two columns. Borrowing is adjustment plus seasonal borrowing, excluding special situation borrowing by size class.

borrowing, was 57 basis points over the last 5-1/2 years. The borrowing relationship seems to have become somewhat more predictable over the last year and one-half, at least until recently. Two-thirds of the time since late 1985, the model misforecast of borrowing given the spread was within plus or minus \$156 million (row 12), and the misforecast of the spread given borrowing was within plus or minus 40 basis points (row 13).

The actual outcomes in recent maintenance periods in terms of the spread-borrowing relationship, however, have tended to differ more from model forecasts than typically has been the case since 1985. In the two recent maintenance periods ending April 22 and May 6, when borrowing moved well above the path assumption owing to tax-related pressures, the federal funds-discount rate spread relative to actual borrowing levels was below what would be consistent with the representative post-1985 experience.¹ Plots for these and following reserve maintenance periods are highlighted on chart 4. For the April 22 and May 6 reserve periods, the average spread was about 1/2 and 1 percentage point, respectively, lower than model predictions given actual borrowing (shown by the heavy line in chart 4). The point for the next period, May 20, moved to above the regression line as borrowings fell, while the funds rate edged down to around 6-3/4 percent. For the June 3 period, borrowing surged over the Memorial Day weekend, owing in part to expectations of a near-term discount rate increase, averaging almost \$800 million for the period; at the same time the funds rate again averaged 6-3/4 percent, about 40 basis points below the model forecast. In the June 17 maintenance period, borrowing averaged \$380 million but the funds rate, which remained near 6-3/4

¹. In late April and early May, the volume of tax flows into the Treasury continued to run well above expectations, making it difficult for the Desk to provide an ample volume of reserves. The appendix discusses this episode in detail.

percent, was around 65 basis points above the model prediction. As explained more fully below, over these periods the federal funds rate has been importantly influenced by market expectations of Federal Reserve intentions as well as by the actual borrowing outcome. The market placed the funds rate near levels it thought was consistent with Federal Reserve policy. The higher borrowing in the earlier maintenance periods reflected a response to the wider yield spread as well as to reserve shortages. It might be noted that with \$500 million of borrowing and a discount rate of 5-1/2 percent, the model would predict a funds rate of around 6-1/2 percent.

Deviations of Borrowing from the Path Assumption

Adjustment plus seasonal borrowing on a two-week reserve-period basis has averaged nearly \$70 million above the path allowance since early 1984, with a standard deviation of about \$170 million, as shown in table 3. (The figures abstract from special situation borrowings by including them with extended credit in nonborrowed reserves.) Excluding the maintenance periods encompassing the three year-ends, when extremely heavy window-dressing or tax-related pressures have emerged, the comparable statistics are \$55 million and around \$160 million.

Several sources of uncertainty in the Desk's reserve management account for these deviations. The miss of borrowing from the path allowance can be broken down arithmetically into the sum of the misses of required reserves and excess reserves from their path expectations, less the miss of nonborrowed reserves from its formal path level. Thus, borrowing will tend to come in higher than assumed if demands for required or excess reserves are higher than built into the path or if actual nonborrowed reserves turn out below its path level. The difference of actual nonborrowed reserves from its

Table 3

SOURCES OF DIFFERENCE OF BORROWING FROM PATH ASSUMPTION¹
(Millions of dollars)
(Figures excluding year-ends in parentheses)

		Mean difference	Mean absolute difference	Standard deviation of difference
1.	Difference of borrowing from path assumption	68 (55)	130 (119)	171 (158)
2.	Equals Difference of required reserves from path expectation ²	27 (24)	91 (89)	113 (113)
3.	Plus Difference of excess reserves from path expectation	89 (74)	166 (153)	201 (183)
4.	Less Difference of nonborrowed reserves from settlement-day expectation due to market factor misses ³	-14 (1)	94 (83)	128 (103)
5.	Less Difference of settlement-day expectation for nonborrowed reserves after open market operations from path level. ³	62 (42)	178 (162)	254 (232)
	Memo: Row 3 and row 5 combined ⁴	27 (32)	137 (138)	177 (178)

1. Uses final revised data for two-week maintenance period averages from period ending March 14, 1984 through period ending June 17, 1987. Special situation borrowing is included with extended credit in nonborrowed reserves.

2. The path expectation of required reserves is formally revised as the maintenance period progresses. The path expectation for required reserves in the table is identical to the settlement-day expectation.

3. Settlement-day expectation is calculated as the projection of nonborrowed reserves made by Board staff on the morning of settlement day plus any Desk addition or drain of reserves on settlement day.

4. This row is derived as a residual from rows 1, 2, and 4. It can be interpreted as consisting of the difference of excess reserves from the settlement-day expectation, plus the difference of the settlement-day expectation of borrowing from the path assumption, plus the difference of the intended addition to nonborrowed reserves from the amount of acceptable propositions, plus other miscellaneous differences.

path can be further broken down into two components. One is the difference—due to market factor misforecasts on settlement day—of actual nonborrowed reserves from its settlement-day expectation after operations have been conducted. The other component is the expected miss from path, that is, the difference of this settlement-day expectation of nonborrowed reserves from its formal path. Table 3 shows this further decomposition, using final revised data for two-week reserve periods to summarize the size of these component differences. While differences from the path for all four components can be fairly sizable, some averaging out of these misses across the four components is evident.

Some of the offsetting misses reflect deliberate decisions by the Desk to move nonborrowed reserves away from the formal path in order to reduce the effects on borrowing of anticipated deviations of other elements from path levels. By late in the maintenance period, the Manager often has a better feel—with more information about carryover and actual funds market pressures—about emerging demands for excess reserves than the formal allowance built into the path. If he expects excess reserves to be above the path allowance, for example, he would tend to adjust the intended provision of nonborrowed reserves above its formal path as well to accommodate the altered assessment of excess reserves demands and prevent borrowing from rising above its path assumption.¹ As another example, at times the Manager may shade his expectation of required reserves away from the path allowance, which is set by the Board staff projection, to take account of the independent New York staff projection, in the process moving his intended level of nonborrowed reserves away from the formal path.

1. The fact that combining row 3 and row 5 results in statistics for the memo item that are lower than the size of the statistics for either of the two rows separately indicates that just such a process of offsetting adjustments is at work.

Not all deviations of expected nonborrowed reserves from path, however, represent attempts by the Manager to reduce divergences of borrowing from the path assumption. At times the Manager may find himself unable to accomplish his intended reserve injection via RP transactions if a shortage of collateral prevents sufficient acceptable propositions from market participants. Or by settlement morning, borrowing already may be averaging so far above the path assumption that hitting the implied nonborrowed reserves path would involve a substantial accumulation of excess reserves or otherwise result in an easing of reserve market pressures at a time when such an easing could mislead market participants as to the underlying intention of the Federal Reserve; in such circumstances, the Manager would intentionally aim for less nonborrowed reserves than in the formal path. On the other hand, sometimes when borrowing is running well below the path assumption, the Manager may intentionally overprovide nonborrowed reserves if there is a reason to damp the sharp tightening in money market conditions implied by the needed rise in borrowing. However, under most circumstances, the Manager operates to achieve the borrowing level, allowing the associated ease or tightness to develop late in the period.

The pattern of yearly misses of borrowing from the path allowance is given in table 4 and shown in chart 2 following page 4. The most sizable average deviations occurred in 1985 and so far in 1987. In 1985, the misses arose primarily from overshoots of excess reserves from the path allowance that typically were not fully compensated for by overprovision of nonborrowed reserves relative to path; excess reserves were on an upward trend throughout the period, and the path allowance tended to lag behind. So far in 1987,

Table 4

DIFFERENCES OF BORROWING FROM PATH ASSUMPTION BY YEAR¹
 (Millions of dollars)
 (Figures excluding year-ends in parentheses)

	Mean difference	Mean absolute difference	Standard deviation of difference
Early 1984 - mid-1987	68 (55)	130 (119)	171 (158)
1984	63 (49)	135 (124)	176 (168)
1985	97 (88)	117 (108)	126 (119)
1986	21 (-2)	107 (87)	157 (105)
1987 ²	115	199	254

1. Uses final revised data for two-week maintenance period averages from the period ending March 14, 1984 through period ending June 17, 1987. Special situation borrowing is included with extended credit in nonborrowed reserves.

2. Maintenance period ending January 15, 1987 through maintenance period ending June 17, 1987.

excess reserves also have tended to average above the expected path allowance. In part this has been compensated for by overprovisions of nonborrowed reserves relative to path. But demands for excess reserves often were very large and greater than compensated for by the Desk—perhaps as it operated cautiously given conditions in foreign exchange markets and confronted collateral shortages. In addition, market factors sometimes resulted in shortfalls of reserves which acted together with a relatively high federal funds rate and strong borrowing early in certain periods in contributing to an overshooting of the borrowing assumption. The experience of the previous intermeeting period is explained more fully in the appendix.

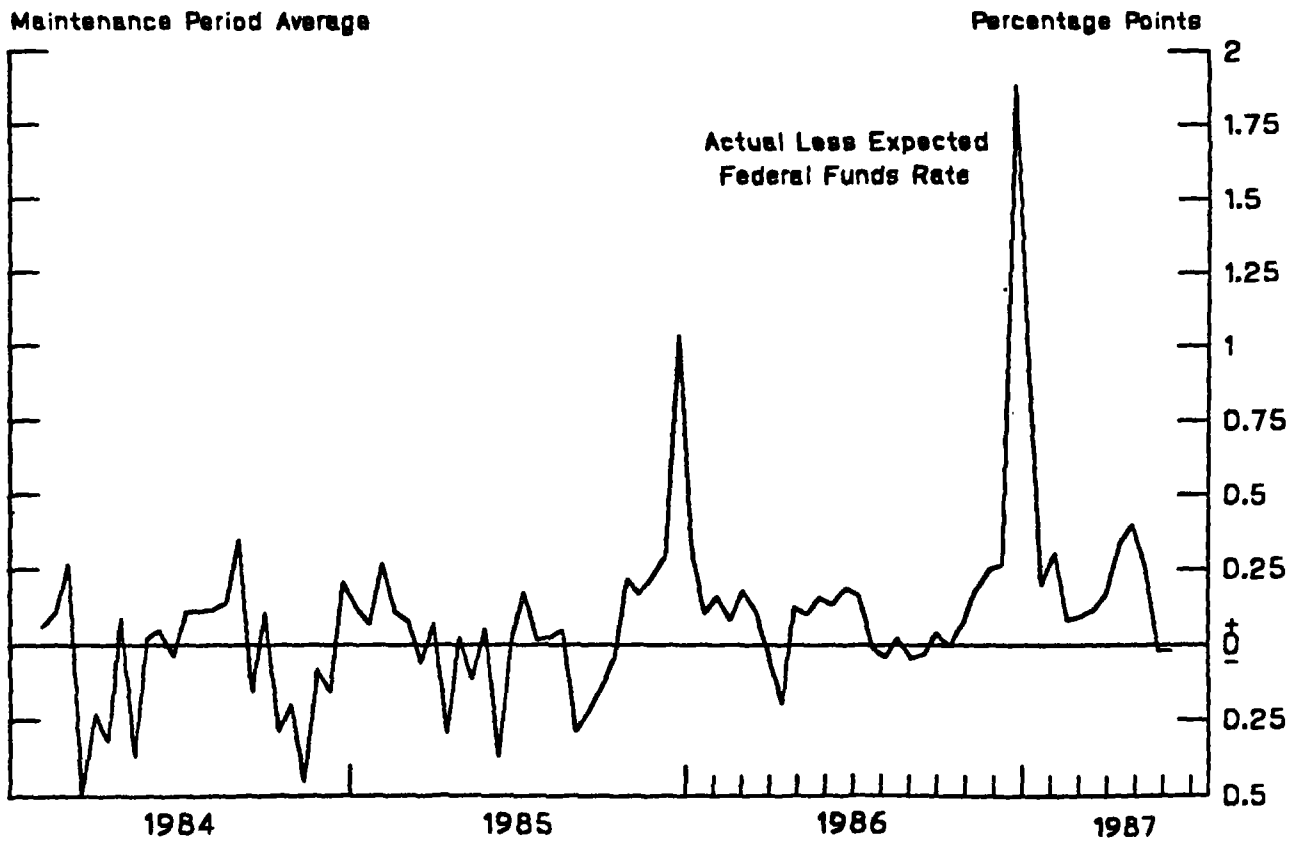
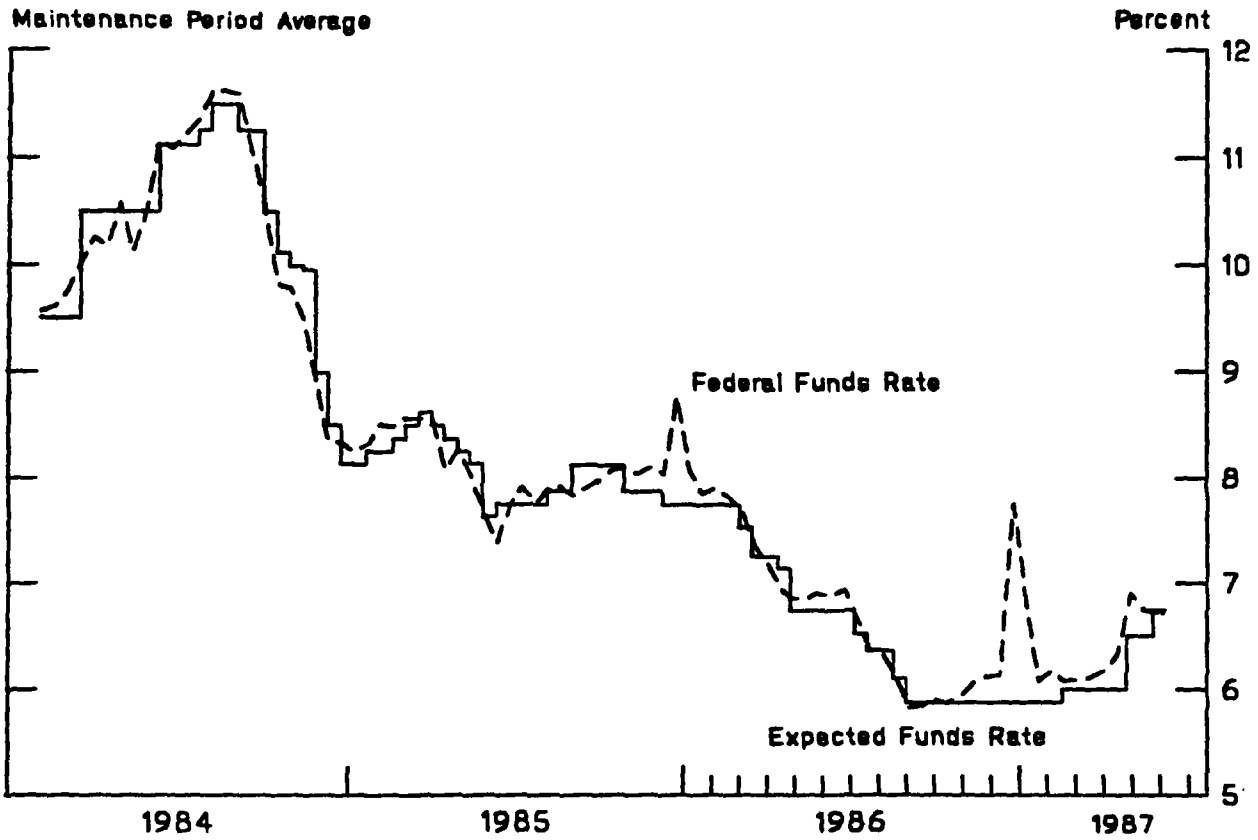
Divergences of the Funds Rate from Expectations

The issue remains as to how variations in the borrowing relationship and divergences of borrowing from path have in fact interacted in producing deviations of the funds rate from expectations. Chart 5 addresses this issue by comparing the actual two-week average funds rate with the expected level of the funds rate announced by the Desk on the morning call each Thursday and the day after discount rate changes. It is the level the Desk expects to be associated with the borrowing assumption and is adjusted when the discount rate or the borrowing assumption is altered and at other times in response to recent experience.

The two series track reasonably closely since February 1984. The notable exceptions reflect year-end pressures in 1985 and 1986. Excluding maintenance periods encompassing year-ends, the funds rate has exceeded its expectation by an average of 5 basis points, with a 16 basis point mean absolute difference and a 21 basis point standard deviation of the difference.

Chart 5

Deviations of Federal Funds Rate from the Desk's Expectation



However, the funds rate averaged about a quarter point above the Desk's expectation even after the reserve market pressures around year-end 1986 abated. The gap in the May 6 maintenance period rose to 40 basis points before the funds rate slipped off to match the expected level in the June 3 reserve period, which was raised further in light of the Committee's decision at the last meeting to seek slightly greater reserve pressures.

The standard deviation of the Desk's forecast error of the funds rate excluding year-ends is about half the standard error of the simple borrowing model over the same time span. The smaller judgmental misforecasts mainly reflect some tendency for misses in borrowing from the path assumption and unanticipated shifts in the relationship of borrowing to the spread to have partly offsetting effects on the funds rate. For example, at times when the funds rate is under upward pressure because borrowing has overshot the FOMC's assumption, institutions typically evidence increased willingness to borrow for any given period-average spread, which serves to relieve the upward pressure on the funds rate.¹ One reason involves the degree to which market expectations help determine the funds rate through the first

1. In statistical terms, the two surprises tend to be negatively correlated. The differences in chart 5 were decomposed into a term equaling 25 basis points times the miss of borrowing from its path assumption, representing the unexpected deviation in the funds rate due to the miss of borrowing, and the remainder, representing roughly the unexpected error (in terms of the funds rate) in the Desk's implicit notion of the location of the borrowing function for that two-week period. The correlation coefficient between the two components of the overall funds rate surprise was $-.75$. A sense of the relative contribution of the two components—the unexpected deviation in the funds rate due to the borrowing miss and the unexpected deviation in the funds rate given both actual borrowing and the Desk's implicit view of the position of the borrowing function—can be gained through summary statistical measures. The variance of the overall funds rate surprise (.09) consists of the variance of the part of the funds rate deviation due to the borrowing miss (.21) plus the variance of the part of the funds rate deviation due to the implied error in the Desk's notion of the borrowing function (.18) plus two times the covariance of the two components ($-.15$).

13 days of the maintenance period before market fundamentals finally emerge more strongly on settlement day as the reserves market clears. Market participants attempt to discern the level of the FOMC's borrowing assumption, and these perceptions—which do not seem to change erratically—are an important influence on the level of funds trading. Thus, market perceptions aid in the mechanism that serves as a basic anchor for the funds rate.¹ In terms of the example, if a reserve shortage temporarily causes more borrowing than the path assumption, the effect of market expectations tends to keep the period-average funds rate from rising as much as the borrowing relation suggests it normally should, resulting in the appearance of a rightward and downward shift in the relation of borrowing to the spread.²

Another reason also helps explain the tendency for short-run movements in the relation of borrowing to the spread, on the one hand, and in actual borrowing relative to its assumption, on the other, typically to have partly offsetting effects on the funds rate. The Desk uses emerging deviations of the actual from expected funds rate as a signal of misforecasts of nonborrowed reserve supply relative to demands for required and excess reserves. However, in cases, for example, when the borrowing function itself unexpectedly is moving to the left and up, tending to raise the funds rate relative to expectations, the Desk's inducement to add reserves will serve to produce

1. During periods when the policy stance is thought to be changing, market participants may have a more difficult time perceiving the System's intended reserve pressure, causing the funds rate to vary over a wider range. This may have been a factor in the experience during the previous intermeeting period.

2. An additional factor limiting the increase in the funds rate is the tendency, noted earlier, for a transitory spike in borrowing to induce a smaller rise in the spread than if the higher borrowing level had been sustained for some time. The recent frequency of the typical borrower's use of the window is lower in the former case, involving less administrative pressure.

less borrowing than the path allowance, thereby relieving the upward pressure on the funds rate. The opposite sort of offsetting response will occur if the borrowing function is moving to the right and down. Either response, of course, tends to offset automatically the effects of transitory variations in the borrowing relationship on the funds rate. And as noted earlier, late in occasional maintenance periods the Desk may intentionally allow borrowing to deviate from path to avoid sharp and potentially misleading variations in funds market conditions.

APPENDIX

STRICTLY CONFIDENTIAL (F.R.)
Class II FOMC

Policy Implementation in April and May 1987

Why Reserves and Borrowing Turned Out as they Did*

The period between the March 31 and May 19 FOMC meetings included a number of unusual events which made both borrowing and the Federal funds rate run higher than might normally have been expected given the policy parameters. A combination of dramatic upward revisions in estimated reserve needs and occasions of deliberate caution in meeting estimated needs early in two of the maintenance periods because of weakness in the dollar, left the Desk having to inject massive amounts of reserves day after day in an effort to catch up with the growing needs. Adding to rate pressures, the reserve shortfalls occurred against a background in which weakness in the dollar and increases in a variety of commodity prices were reigniting inflationary worries. Market participants responded by pushing up interest rates as they anticipated a less accommodative stance toward reserve provision, possibly to be followed with an increase in the discount rate.

The most significant and persistent development from the perspective of reserve management was the extraordinarily large tax inflows to the Treasury. These pushed the Treasury's balance at the Federal Reserve far above previously experienced and expected levels. While all of the reserve forecasters had allowed for more tax payments than usual, they did not capture the extent and persistence of the increases. The high tax payments also caused transactions balances, and consequently required reserves, to be substantially higher than expected in the latter part of April.

* Prepared by Ann-Marie Meulendyke. Extensive assistance was provided by Martin Gonzales and Stephanie Murphy.

This paper first reviews Treasury cash flows during the April-May intermeeting period to highlight the nature of the underestimates and the apparent causes. We find that relatively large tax payments were widely expected, and the Treasury made considerable effort to prepare for them. However, the forecasters at the Treasury, Board, and New York Fed did not fully grasp their extent.

The paper then looks at reserve management, highlighting the role of the misses in the Treasury balance. The occasions of initially grudging reserve provision in response to dollar weakness early in the April 22 and May 6 periods, did make the subsequent shortfalls somewhat harder to overcome, and added some vulnerability to higher borrowing and increased Federal funds rates. However, the reserve shortfalls linked to the Treasury balance overshoots were so large in the May 6 period that the Desk would have run far behind in meeting actual reserve needs even if it had been keeping pace with the estimated needs. Shortages of collateral added to the problem on a few days, preventing the Desk from accomplishing the full amount of intended reserve injections. Those shortages coincided with some of the days when the banks borrowed substantially more than the path allowance.

Treasury cash flows and forecasts

The levels reached by the Treasury balance and the magnitudes of the revisions were extraordinarily large. The Treasury's total cash balance peaked on April 30 at \$55.7 billion, with \$29.7 billion at the Federal Reserve. The previous all time highs for both the total Treasury balance and the balance at the Federal Reserve were reached on May 2, 1985, when they peaked at \$40.8 billion and \$19.9 billion, respectively.

The Treasury had not intended to run this year's balance to record levels. When it had observed in January that tax payments and consequently

cash balances were running above normal, it began to cut back on its borrowings. It paid off a portion of the maturing 3- and 6-month bills in most auctions beginning with January 22. From then until May 19, the cumulative decline in bills outstanding was \$25.7 billion. It also cut back modestly in the sizes of a few coupon auctions, although mostly it held them at earlier levels. Previously, it had been increasing the auction amounts. Consequently it raised far less new money than in early 1986, and it came into April with lower than usual balances, which required large cash management bill sales to span the low cash period early in the month. It had hoped that these steps would make room for relatively high April tax payments without causing its balance to reach unusual heights.

Even with such efforts, the balance at the Federal Reserve was expected to run somewhat above the normal \$3 billion working level. When the Treasury's total cash rises above the capacity of the Treasury Tax and Loan (TT&L) accounts at commercial banks (recently around \$26 to \$27 billion) it must hold the extra at the Federal Reserve, thereby draining reserves. If the Desk is to achieve the desired level of nonborrowed reserves (NBR) in the banking system, it must add reserves to offset the drain.

April 15 is both a corporate and individual tax payment date. For corporate taxes, the bulk of the funds reach the Treasury accounts in the two days after the tax date. The staffs did a reasonably good job of capturing the size and timing of the corporate tax payments. Their estimates of total tax payments on those days were very close to the \$17.5 billion

that occurred.^{1/} The problems came in projecting individual nonwithheld income taxes. Because of the change in tax laws applicable to income in 1987 and beyond, particularly the less favorable treatment of capital gains, many individuals, or mutual funds, took actions to realize gains in 1986.

Three sets of projections of April nonwithheld taxes were available, made by New York, Board, and Treasury (tax analysis) staffs. They are listed in Table 1. As can be seen, actual tax payments processed in April and May of 1987 exceeded 1986 payments by about \$25 billion or 46 percent. While each of the forecasts allowed for more taxes this year, all of the forecasts fell far short of the final amount for 1987--by a range of \$13 to \$20 billion.

The other aspect of the forecasting job is gauging the speed with which the tax receipts will be processed. That depends upon how quickly and efficiently the IRS processing centers operate. Past experience had been variable, with severe delays in 1985 but relatively smooth processing in 1986. Conversations by the projectors with the IRS suggested no major problems were expected this year, and indeed there apparently were none. In such a circumstance, the projectors expected that the volume of inflows would rise day by day until the bulk of the processing was complete, then decline. The taxes actually arrived a bit unevenly, with surges interspersed with slower days. The large day-to-day flows right after the tax date were interpreted not as an indication that the total payments would be much higher than forecast, but as a corroboration that processing was indeed

^{1/} Of this total, \$13.3 billion was corporate taxes; the balance was in withheld taxes. Given uncertainties about 1987 tax regulations, the IRS had ruled that corporations would not be subject to an underpayment penalty if they paid 120 percent of 1986 taxes for April. Actual payments were 119 percent of the 1986 total.

Table 1

Individual Nonwithheld Income Taxes*
(in billions of dollars)

ACTUAL RECEIPTS

	<u>1986</u>	<u>1987</u>	<u>Increase</u>	<u>Percent Increase</u>
April	49.1	70.3	21.2	43
May	4.5	8.1	3.6	80
April-May	53.6	78.4	24.8	46

FORECAST FOR 1987#

	<u>New York</u>	<u>Board</u>	<u>Treasury</u>
April	53.9	55.4	60.1
May	4.8	5.6	5.6
April-May	58.7	61.0	65.7
Underestimate	19.7	17.4	12.7

* Budget basis: Includes nonwithheld social security taxes paid by self-employed individuals.

Forecasts made February-March 1987.

going smoothly, and would be completed promptly. The forecast errors, thus, arose in part because of underestimates of the total tax take and in part from difficulties in interpreting the day-to-day flows.

The Treasury cash flow forecast errors caused two types of problems for reserve management. First, the underprediction of the total flows caused the Desk to underprovide reserves. Second, the day-to-day misses made reserve availability to the banking system rather volatile, and contributed to the variability in the Federal funds rate and borrowing. Table 2 shows measures of three staffs' daily errors in forecasting the Treasury balances at the Federal Reserve during the maintenance periods in question. In the May 6 period, the Treasury's better overall performance left them with smaller day-to-day errors than either of the other staffs. In the other periods, the picture was mixed.

Reserve Operations

The reserve shortfalls stemming from the Treasury balance misses were a major factor in creating the pressures that led to instances of higher than expected borrowing and Federal funds rates. The misses and occasions of divergent estimates made it hard for the Desk to feel comfortable in relying on the forecasts. The misses interacted with Desk caution in meeting reserve needs when the dollar was under assault in the foreign exchange markets, and with a market that was nervous about inflation and attuned to expecting higher interest rates and a tighter Federal Reserve policy. This section considers the maintenance periods in the intermeeting period in some detail, examining the reserve forecasts, the efforts to meet the needs, and the reserve pictures on the days when the high amounts of borrowing took place.

Table 2

Errors in Same Day Treasury Balance Forecasts

	<u>New York</u>	<u>Board</u>	<u>Treasury</u>
April 22 maintenance period			
- Average Error	125	-341	-414
- Average Absolute Error	1,036	827	776
May 6 maintenance period			
- Average Error	-1,064	-1,721	-618
- Average Absolute Error	1,283	1,832	937
May 20 maintenance period			
- Average Error	-142	-467	-239
- Average Absolute Error	496	538	271

Note: Friday forecasts are treated as single observations.

At the start of the reserve maintenance period ended April 22, the Desk was given estimates by the New York and Board staffs that the Treasury balance at the Federal Reserve would either drain \$60 million or add \$180 million of reserves on average over the two weeks--in both cases, a minimal change. In fact, the sharp rise in the balance to \$9.4 billion by the end of the period drained an average of \$800 million of reserves for the period as a whole. In addition, required reserves turned out to be higher than expected at the start of the period by \$630 million, which further enlarged the need to add reserves by raising the NBR objective. Other uncontrolled factors drained about \$700 million more reserves (New York staff), or \$1.5 billion more reserves (Board) than originally estimated. Altogether, the need to add reserves was \$2.1 to \$3.2 billion greater than expected at the start of the period. (Table 3 gives highlights of the reserve forecasting errors.)

By midperiod, the New York staff had incorporated much of the Treasury balance shortfall, but neither staff was aware of the revisions to required reserves and to other reserve factors. By the final day (April 22), the staffs were actually overestimating reserve availability modestly, but required reserves were still underestimated. On balance, the estimated need to add reserves was nearly correct. However, on that day, because of earlier shortfalls, there was a very large need to add reserves, calling for \$10 to \$11 billion of RPs. There were great uncertainties about the forecasts, and the Desk was skeptical that the need was that large. However, that question proved moot because, when the Desk announced RPs, it received far fewer propositions than it had hoped. It arranged \$5.6 billion, accepting almost all propositions.

Table 3

**Selected Forecast Errors
for the April and May Intermeeting Periods
(in millions of dollars)**

	<u>Required Reserves</u>		<u>Reserve Factors</u>		<u>Treasury Balance</u>			<u>Reserve Factors less Treasury Balance</u>	
	<u>Board*</u>	<u>New York</u>	<u>Board</u>	<u>New York</u>	<u>Board</u>	<u>New York</u>	<u>Treasury</u>	<u>Board</u>	<u>New York</u>
Maintenance Period Ended April 22									
<u>As of:</u>									
Thurs. April 9	-630	-1,026	-2,527	-1,490	-992	-751	-1,300#	-1,535	-739
Thurs. April 16	-787	-862	-1,388	-713	-603	-145	-600#	-785	-568
Wed. April 22	-148	-175	96	190	4	217	74	92	-27
Maintenance Period Ended May 6									
<u>As of:</u>									
Thurs. April 23	-808	-720	-6,532	-7,094	-7,431	-7,567	-4,600#	899	473
Thurs. April 30	13	-26	-2,761	-2,717	-2,713	-2,559	-1,700#	-48	-158
Wed. May 6	-26	-79	-115	-76	7	38	+54	-122	-114
Maintenance Period Ended May 20									
<u>As of:</u>									
Thurs. May 7	144	-71	-3,729	-1,903	-3,249	-1,734	-2,200#	-480	-169
Thurs. May 14	148	66	-845	107	-261	574	-400#	-584	-467
Wed. May 20	-53	-75	147	162	-31	7	-23	178	155

* Used for estimating reserve path.

Derived from numbers that were rounded to the nearest \$100 million.

A negative number implies an underestimate of reserves needed to achieve the path level of nonborrowed reserves.

That left reserves relatively plentiful on the day but very short on the period. It was estimated that if banks had borrowed only the \$300 million path amount that day, they would have had only a bit over \$400 million of excess reserves for the period, well below the \$850 million expected. In fact, borrowing swelled to \$5.3 billion, lifting the period's average to almost \$700 million. (Table 4 gives summary statistics on the outcomes of the periods.)

The shortage of reserves in the April 22 period made borrowing almost inevitable on the settlement day. Early in a maintenance period, in contrast, banks have a greater tolerance for cumulative average shortages but that tolerance diminishes as the period progresses. Banks also have a varying tolerance for shortages on a given day. Concern about overdrafts seems to be the major constraint on one-day shortages. The ability to cope with single day shortages seems to depend on the volume of flows through the reserve accounts.^{2/} High borrowing would be expected to occur if reserves were very scarce on the day or if the cumulative average excess reserve position were very short relative to the banking system's normal demands for reserves.^{3/}

^{2/} The main sources of heavy flows are social security distribution days (May 1 during the period in question), days of major Treasury debt settlements (May 15), and month-ends. On those days, even a small reserve deficiency could introduce clearing pressures. On other days, a larger reserve deficit should be tolerable if there is not a big cumulative reserve deficiency.

^{3/} Table 5 offers further perspective on April 22, and on all other days in which borrowing exceeded the objective by \$200 million or more, (column 1). It shows what the Desk thought that excess reserves would be both on the day, (column 2), and for the period to date, (column 3), after it completed that day's open market operations. Columns 4 and 5 repeat the calculations using revised figures to show what excess reserves actually would have been if borrowing had been on path on the day in question but all other numbers took on actual values.

Table 4

Summary of Reserve Measures and the Federal Funds Rate

<u>As of</u>	<u>Period Ended</u>	<u>Required Reserves</u>	<u>ER</u>	<u>Adj. & Seas. BR</u>	<u>NBR & ECB</u>	<u>NBR Objective</u>	<u>Anticipated Adj. & Seas. BR</u>	<u>Assumed ER</u>	<u>Average Eff. Fed Funds (Range of daily effective rates)</u>
Apr. 24	Apr. 22	59,559	928*	689	59,798*	60,105	300	850	6.34 (6.05-6.78)
June 4		59,703	804	"	59,817	"	"	"	
May 8	May 6	58,129	979*	1,111	57,998*	58,530	300/400(a)	850	6.90 (6.29-7.67)
June 4		58,106	1,024	"	58,019	"	"	"	
May 22	May 20	56,907	1,221*	554	57,575*	57,305	400	850	6.76 (6.60-6.88)
June 4		57,041	1,088	"	57,575	"	"	"	

* Based on Board staff estimate of applied vault cash.
(a) The borrowing assumption was raised on April 30.

Note: Reserve measures are preliminary for about one month. Figures may not add due to rounding.

ER = excess reserves
BR = borrowed reserves
ECB = extended credit borrowing.

Table 5

Reserve Picture on Days When Borrowing Exceeded
the Path Assumption by \$200 million or more

<u>Maintenance Period:</u>	<u>Actual BR on the day</u>	<u>As it looked at the time</u>		<u>As it looks with revised reserve data</u>	
		<u>Expected ER on the day, after operations*</u>	<u>Expected cum. av. ER after operations*</u>	<u>ER on day*</u>	<u>Cumulative ER*</u>
<u>Ended Apr. 22</u>					
Fri. Apr. 10	618	-36	-554	-1,032	-1,521
Tues. Apr. 14	564	+1,044	-81	-1,889	-1,519
Wed. Apr. 22	5,315	+1,950	+432	+3,802	+444
<u>Ended May 6</u>					
Tues. Apr. 28	517	-329	-992	-3,029	-1,448
Wed. Apr. 29	755	-2,477	-1,781	-6,732	-2,172
Thurs. Apr. 30	2,125	-1,521	-2,205	-5,736	-2,561
Fri. May 1	2,527	+5,639	-311	+7,147	+244
Wed. May 6	1,511	-1,901	+925	-1,521	+945
<u>Ended May 20</u>					
Mon. May 18	616	-3,414	+1,719	-4,113	+1,777
Wed. May 20	1,301	-3,792	+1,371	+1,025	+1,026

*All figures assume borrowed reserves on the day were equal to the \$300 or \$400 million path allowance.

The events of the April 22 maintenance period turned out to be just a warmup for the following period. In the May 6 period, the average level of the Treasury balance at the Federal Reserve exceeded the levels forecast at the start of the period by an astounding \$7.4 to \$7.6 billion. (The Treasury missed by about \$4.8 billion.) Furthermore, the Board staff initially underestimated required reserves by about \$800 million, chiefly reflecting an underestimate of transactions balances related to the enlarged tax payments. There was a moderate offset in that early estimates of reserve needs from other factors turned out to be overstated by \$500 to \$900 million. In the middle of this period, the Board staff had revised required reserves to compensate for the initial underestimate, but estimates of the Treasury balance were still about \$2 1/2 billion too low. By the final day, the estimates were reasonably close.

The initial underestimates meant that the Desk had to add far more reserves than expected. But even at the start of the period, the Desk faced a need that appeared to be fairly large at the time--\$3.2-\$3.7 billion. The first few days' estimates suggested that the reserve need would be larger in the latter part of the period. With the state of the dollar rather fragile, and giving effect to the Committee's guidance to resolve uncertainties on the side of less accommodation, the Desk initially added reserves cautiously. The Desk arranged only a customer RP on the first day and no market operations on the first Friday, but the banks still came through the weekend with large estimated excess reserves. (Revised figures for required reserves showed that most of the cumulated excess reserves had been used up already by Monday morning, and that by Tuesday, a reserve deficit had been accumulated.) On Monday, April 27, the decision of whether to stay out of the market or do a customer-related RP was a close call. Federal funds were trading around 6 7/16 percent, near the high end of the recent range, but

the dollar remained fragile in the exchange market. Accordingly, the Desk decided to wait until the estimated sizable accumulation of excess reserves had been worked off. Its absence was seen by the markets as a signal--later confirmed by Chairman Volcker--that a "snugging" had occurred. The markets responded positively to these developments, as indications that the System was prepared to "do something" about the dollar.

The estimated reserve needs grew day after day from then on. The shortages, along with month-end and social security pressures and expectations of a possible discount rate increase, put extra upward pressure on the Federal funds rate which traded mostly between 6 1/2 and 7 1/2 percent in the latter half of the maintenance period. The Desk played catch up, arranging massive amounts of RPs and picking up Treasury bills from foreign accounts at every opportunity.

When it fell behind, borrowing rose. On Wednesday, April 29, there was a significant collateral shortage. The Desk had indicated an intention to arrange \$8 billion or more of RPs, but only received \$6 billion of propositions, and accepted \$5.5 billion of them. The next day, the Desk hoped to do \$8-\$10 billion of RPs. It received \$8.7 billion of propositions and arranged \$7.4 billion of RPs. The rates on those turned down were relatively unattractive, and acceptance of those low rates might have encouraged more early withdrawals, thus not really adding to reserve availability. As can be seen from table 5, reserves appeared scarce even at the time as a result of the earlier reserve shortfalls and the collateral shortages. Further revisions, mostly to the Treasury balance, left reserves far shorter than had been thought at the time, and made high borrowing on those days very likely. The Desk responded to the collateral problems and

large reserve needs by preannouncing on April 30 its RPs for May 1; it managed to arrange the full intended complement, a record \$13.9 billion. Plentiful reserves on the day did not preclude heavy borrowing, probably because a few banks saw the weekend as a good time to offset their cumulative deficiencies.

During the entire May 6 maintenance period, the Desk executed enough open market operations to lift the average level of reserves by \$12.5 billion (not including the \$2.2 billion purchase of coupon securities just before the period began). In doing so, it arranged an unprecedented \$45.8 billion of RPs and bought \$2.2 billion of bills from foreign accounts. The Desk met all but about \$500 million of the need. It permitted that shortfall because by the closing days of the period, an overrun of borrowed reserves was already a mathematical necessity and fulfillment of the nonborrowed reserve path might well have provided misleading signals to the market.

In the May 20 maintenance period, Treasury balances again exceeded initial expectations. This time, lower than expected expenditures rather than tax flows caused the miss. The Desk did not run behind overall, but did face frequent daily revisions. There were two days of relatively high borrowing that period. On May 18, there was a projected surplus of reserves for the period, but a shortage on the day. The shortage looked manageable given the cumulative excess reserves. It was a close call, with the Desk choosing to avoid adding further to the surplus by refraining from doing a customer RP. Again reserves turned out to be scarcer than expected. The other day of high borrowing was May 20, the settlement day. That day there was a cumulative reserve excess, thought to be very large. The Desk arranged matched sale-purchase agreements on the day to reduce the overage.

The amount arranged was insufficient to bring reserves down to the path average, but was a bit larger than initially contemplated because the substantial volume of propositions suggested that the banks also saw themselves with unwanted reserves.

In the end, however, there was a large reserve shortfall on the day. Reserves were not so plentiful as expected, but were still above path. The borrowing reflected high demands for excess reserves and, after the fact, further upward revisions to required reserves. For the period, reserves exceeded the path level modestly, although borrowing was modestly above path as excess reserve demand proved strong.