Reserves Forecasting for Open Market Operations

Thirty years ago Robert Roosa made a distinction between "defensive" and "dynamic" open market operations that continues to be meaningful today despite many changes in the financial system. Defensive operations, he noted, are directed at "avoiding mechanical disturbances that could interfere with the smooth functioning of the monetary system," while dynamic operations are aimed at "using the potentialities of control over the reserve base of a fractional reserve banking system to help promote economic growth within a pattern of sustained stability."[1] The mechanical disturbances Roosa referred to are the result of technical factors that affect the demand and supply of bank reserves, such as seasonal variations in the public's need for currency, and the routine flow of funds among the U.S. Treasury, individuals, and businesses. The influence of these factors must be accounted for in the conduct of open market operations in a "defensive" sense so that the "dynamic" objective, namely the stance of monetary policy as specified by the Federal Open Market Committee (FOMC), can be achieved. As a result, the Open Market Trading Desk here at the Federal Reserve Bank of New York uses estimates of the volume of open market operations necessary for purely defensive purposes. Likewise, private financial analysts ("Fed-watchers"), in attempting to understand whether a given Federal Reserve operation signals a change in the stance of monetary policy, make similar estimates of the need for defensive operations.

While the Federal Reserve's operating procedures have been carefully analyzed with respect to dynamic objectives,[2] much less attention has been paid to some recent changes in the financial system that pertain to the defensive side of operations. In particular, the extension of reserve requirements to virtually all depository institutions, the pricing of Federal Reserve services (especially float), and the shift from lagged to contemporaneous reserve requirements all have important implications for estimating the appropriate level of defensive open market operations.

This article describes the behavior of the technical factors that affect the demand and supply of bank reserves and the procedures for estimating these factors, highlighting the impact of recent changes in the financial system. The article is divided into four sections. Section I presents a general overview of various reserve concepts and identities, and using these relationships shows how the Desk relies on forecasts of bank reserves. The next two sections provide details on the various factors that affect the demand for reserves. Required reserves are discussed in Section II and the demand for excess reserves is reviewed in Section III. Section IV covers the factors that affect the supply of reserves.

Overall, the analysis shows that in many ways the task of forecasting the demand and supply of bank reserves has not changed much since the 1950s. Early descriptions of

The authors would like to thank Joan Piasecki and Lisa Johnson for their assistance

[1] Robert V Roosa, *Federal Reserve Operations in the Money and Government Securities Markets*, Federal Reserve Bank of New York (July 1956), page 105

[2] In particular see Henry C Wallich, "Recent Techniques of Monetary Policy," address to the Midwest Finance Association, Chicago, Illinois (April 5, 1984), reprinted in *Economic Review*, Federal Reserve Bank of Kansas City (May 1984), pages 21-30 and Stephen H Axilrod, "U S Monetary Policy in Recent Years An Overview," *Federal Reserve Bulletin*, Board of Governors of the Federal Reserve System (January 1985), pages 14-24 An international comparison can be found in "Changes in Money Market Instruments and Procedures Objectives and Implications," Bank for International Settlements (March 1986)

various aspects of this process that still hold true today can be found in articles by Irving Auerbach, Hobart Carr, Madeline McWhinney, Paul Meek, Robert Roosa, Paul Volcker, and others.[3] In some respects, however, the process has evolved over time, and the purpose of this article is to highlight these changes as well as to bring together a description of all the factors involved.

I. Overview of bank reserves

The factors that influence the demand and supply of bank reserves are presented in general terms in Chart 1. This schematic representation of the well-known reserve relationships describes the demand for total reserves (TR) during a given reserve maintenance period (t) as the sum of required reserves (RR) and excess reserves (ER).

$$(1)\quad TR_t = RR_t + ER_t$$

On the supply side, TR is equal to reserves borrowed from the Federal Reserve discount window (BR) plus nonborrowed reserves (NBR).

$$(2)\quad TR_t = BR_t + NBR_t$$

Changes to the supply of nonborrowed reserves (ΔNBR) come from two sources: changes in the Federal Reserve's portfolio of U.S. Government and Federal agency securities, *i.e.,* open market operations (OMO) and changes in technical reserve factors (ΔRF).

$$(3)\quad \Delta NBR_t = OMO_t + \Delta RF_t$$

In terms of the level of nonborrowed reserves, equation (3) can be rewritten as:

$$(4)\quad NBR_t = NBR_{t-1} + OMO_t + \Delta RF_t$$

Setting the alternative concepts of total reserves from equations (1) and (2) equal:

$$(5)\quad RR_t + ER_t = BR_t + NBR_t$$

and replacing NBR_t in equation (5) by equation (4):

$$(6)\quad RR_t + ER_t = BR_t + NBR_{t-1} + OMO_t + \Delta RF_t$$

gives the following expression for open market operations:

$$(7)\quad OMO_t = [RR_t + ER_t - BR_t] - [NBR_{t-1} + \Delta RF_t]$$

That is, reserves supplied through open market operations are equal to the difference between the demand for nonborrowed reserves (in the left bracket) and the available supply (in the right bracket), where the supply is expressed as the level of nonborrowed reserves in the prior period plus reserves provided by the reserve factors. This equation is operationally significant because under current procedures the Trading Desk derives a target path for nonborrowed reserves by using an assumption for discount window borrowing ($\overline{BR}$) consistent with the degree of reserve pressure indicated by the FOMC.[4] Using hats (Λ) to denote items that are not known with certainty and therefore must be estimated, we can rewrite equation (7):

$$(8)\quad OMO_t = [\hat{RR}_t + \hat{ER}_t - \overline{BR}_t] - [NBR_{t-1} + \hat{\Delta RF}_t]$$

The items in the brackets in equation (8) can then be combined to show that open market operations in a given period are directed toward meeting the difference between the derived path for nonborrowed reserves—denoted with an asterisk (*)—and the projected supply of nonborrowed reserves.

$$(9)\quad OMO_t = \overset{*}{NBR}_t - \hat{NBR}_t$$

Since the nonborrowed reserve path is based on projections of required reserves and an allowance for excess reserves, which is based partly on projections, the path is subject to change as these estimates are updated. Similarly, the forecast of the supply of nonborrowed reserves changes as projections of the reserve factors are revised. Thus, the Desk is confronted with uncertainty for both the demand and supply of reserves. In practice, therefore, the projections are used cautiously since unexpected changes in the component forecasts can cause considerable swings from day to day in the estimates of the amount of reserves the Desk needs to add or subtract—the amount of "defensive" open market operations — to achieve the "dynamic" objectives of the FOMC.[5] How the forecasts are made will be covered in the next three sections.[6]

[3] Several articles by these authors can be found in the following Federal Reserve Bank of New York publications *Bank Reserves—Some Major Factors Affecting Them* (November 1953), *The Treasury and The Money Market* (May 1954), and *Essays in Money and Credit* (December 1964) Also see Roosa, *op cit*, and Paul Meek, *Open Market Operations*, Federal Reserve Bank of New York, fifth edition (August 1985)

[4] For more detail, see "Monetary Policy and Open Market Operations in 1985," this *Quarterly Review,* page 34

[5] For a discussion of how the Trading Desk has used forecasts of bank reserves and other sources of information as guides for open market operations, see Roosa, *op cit*, pages 64-79 Also, Robert G Rouse, "Implementation of the Policies of the Federal Open Market Committee," statement before the Joint Economic Committee of the Congress (June 1, 1961), reprinted in *Monthly Review,* Federal Reserve Bank of New York (July 1961), pages 126-129 A detailed description of current procedures appears in Meek, *op cit*

[6] Independent forecasts of both the demand and supply of bank reserves are made daily by staff at the Board of Governors and at the Federal Reserve Bank of New York This article focuses on the procedures used at the Federal Reserve Bank of New York

II. The demand for required reserves

The demand for reserves stems primarily from reserve requirements on bank deposit liabilities, as specified in Federal Reserve Regulation D.[7] Required reserves are divided between amounts determined by the level of transactions accounts,[8] and by the level of nontransactions accounts and other reservable liabilities (Chart 1). These two components are distinguished by the applicable reserve ratios (the percentage of deposits that must be held as reserves)[9] and the time lag between when reservable deposits appear on the books of the reporting bank and when reserves against those deposits must be held. Reserves are held during two-week maintenance periods either as deposits with the Federal Reserve or as vault cash

The most significant change in recent years to affect the behavior of required reserves, and hence the task of forecasting them, was the introduction of contemporaneous reserve requirements (CRR) in February 1984 Under the previous system of lagged reserve requirements, the level of reservable bank deposits in a given one-week period determined the level of required reserves two weeks later In this way both banks and the Federal Reserve knew in advance the major component of the demand for reserves during any reserve maintenance period Under CRR, reserve requirements on certain nontransactions accounts are still calculated on a lagged basis, but the larger share (approximately 75 percent) of total required reserves is based on transactions accounts and must be held almost simultaneously with the underlying deposits. The following subsections provide more detail on the two components of required reserves.

Required reserves on nontransactions accounts

The only portion of required reserves that is known in advance of the reserve maintenance period is required reserves on nontransactions accounts. Specifically, this is the requirement on nonpersonal time and savings deposits with original maturities of less than one and one-half years, net

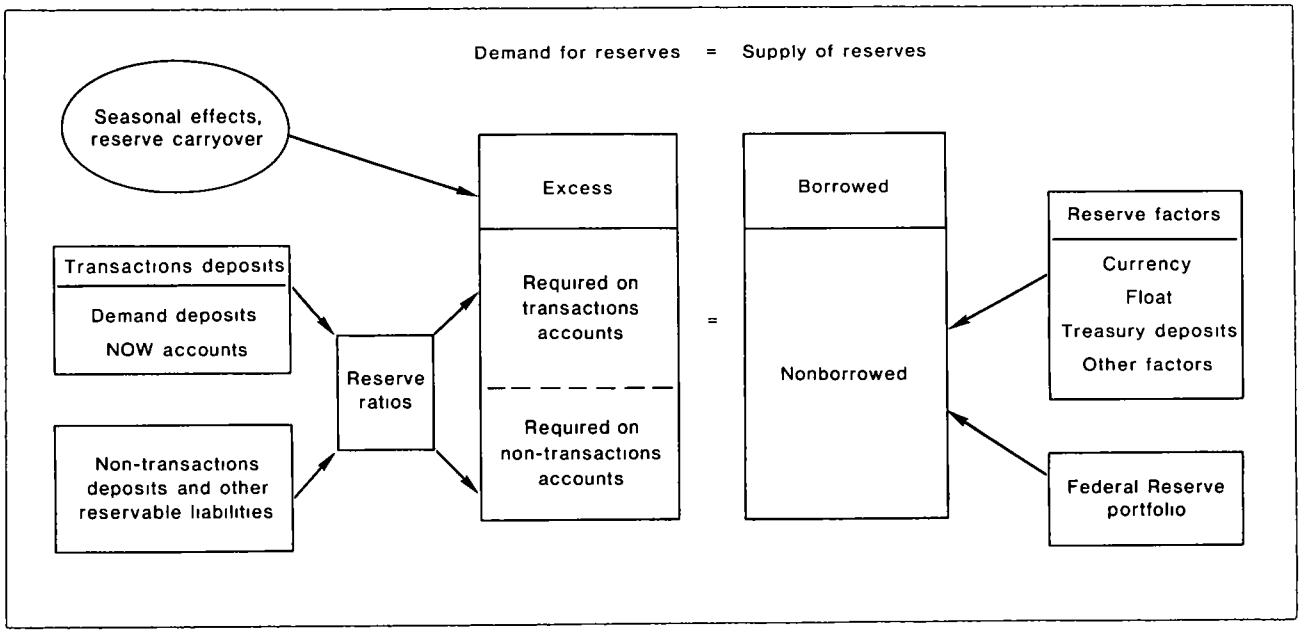
7 In this article the term "bank" refers to all depository institutions that are subject to reserve requirements This includes domestic commercial banks, thrift institutions, credit unions, agencies and branches of foreign banks, and Edge Act corporations

8 Transactions accounts include all deposits on which the account holder is permitted to make withdrawals by negotiable or transferable instruments, payment orders of withdrawal, and telephone and preauthorized transfers in excess of three per month for the purpose of making payments to third persons or others

9 Transactions accounts are subject to a 12 percent reserve requirement, except that a 3 percent ratio is applied to the first $31 7 million Reservable nontransactions liabilities are subject to a 3 percent reserve requirement In addition the first $2 6 million of reservable liabilities have a zero reserve requirement These dollar limits are adjusted annually as described in Footnote 14

Chart 1

Total Bank Reserves



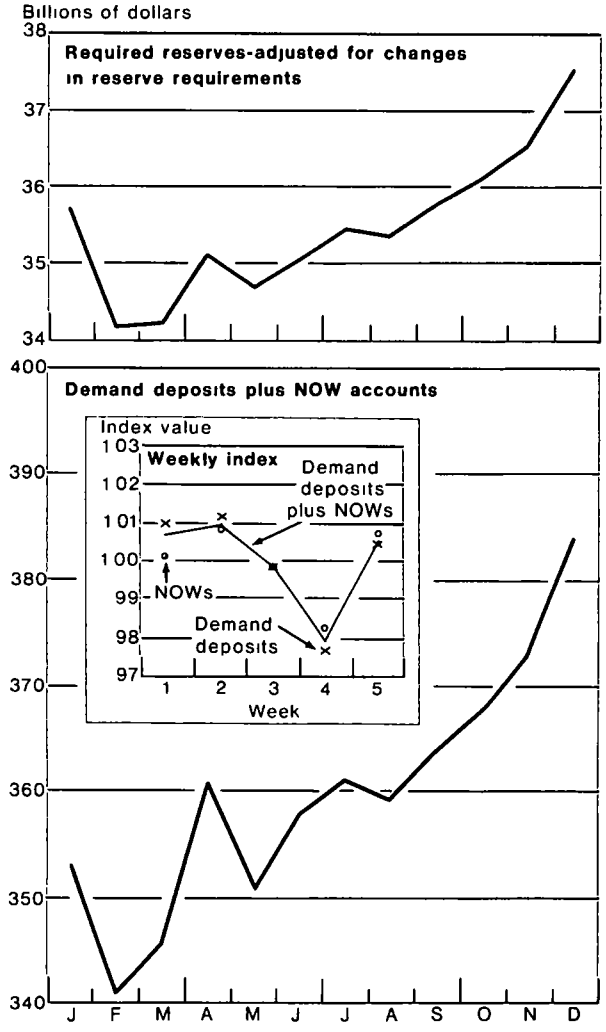
liabilities to foreign banking offices, and certain other Eurocurrency liabilities. These deposits are averaged over two-week intervals called computation periods, which end 17 days before the start of the maintenance period. This lag allows sufficient time for data on their reserve requirements to be collected and included in the estimate of total required reserves

Chart 2

Required Reserves and M1 Deposits

Average monthly levels 1981-85

Not seasonally adjusted



Source Board of Governors of the Federal Reserve System

Required reserves on transactions accounts

In contrast, the lag between the computation period for transactions accounts and the maintenance period for their reserve requirements is very short. Transactions deposits are averaged over two-week intervals ending on alternate Mondays, and the maintenance period ends two days later on alternate Wednesdays. As a result of this brief lag, reserve requirements on transactions accounts for all banks are not known with reasonable certainty until about a week after the reserve maintenance period has ended. During the maintenance period they must be estimated based on forecasts of the underlying deposits [10]

The forecasts of transactions deposits focus primarily on four distinct deposit categories. private nonbank demand deposits, interest-bearing checkable deposits (primarily negotiable order of withdrawal [NOW] accounts); interbank demand deposits; and U S Government demand deposits The first two categories are the deposit components of the narrowly defined money supply, and hence, the forecasts of required reserves are tied directly to the short-term patterns in M1 The other two deposit categories are not included in any of the current definitions of the money supply, but under Regulation D are considered reservable transactions accounts.

M1 deposits

The patterns in required reserves are dominated by the behavior of deposits counted in M1. As shown in the top panel of Chart 2, which contains monthly data averaged over the 1981-85 period, required reserves exhibit an upward trend over the year, as well as pronounced seasonal movements. The underlying M1 deposits are shown in the lower panel. Deposits fall sharply early in the year as the public's demand for money subsides following the holiday period. A seasonal peak then comes in April and a runoff in May, reflecting the buildup in money balances for the payment of Federal income taxes. The second half of the year is characterized by a generally steady rise in deposits, which reach a high point in late December.

The monthly deposit forecasts generally follow these rough intra-yearly patterns. However, this is not always a sufficient guide. The deposit patterns presented in Chart 2 cover a five-year period, and conceal a fairly wide range of variability in the monthly data. In actuality, the behavior of bank deposits will depend on normal seasonal influences, some element of random variation, and probably most importantly the effect of general economic conditions on the public's demand for M1. In recent years deregulation of consumer checking accounts, as well as other regulatory changes, has affected the relationship between M1 and oth-

[10] For those large commercial banks that submit deposits data to the Federal Reserve on a daily basis, reserve requirements on transactions accounts can be estimated reasonably well toward the end of the maintenance period

er economic variables making it difficult to use past deposit patterns to forecast future movements.

Once the monthly deposit estimates are made, a set of consistent weekly values is derived. There is considerable variation in weekly deposit data, and while some clear seasonal patterns are evident there is also a large random element. The initial weekly forecasts are constructed to follow the typical seasonals, and are updated several times each week based on reports submitted by banks to the Federal Reserve.

The "typical" intra-monthly pattern in M1 deposits is shown in the insert to Chart 2. The figures plotted here are the ratios of the average weekly levels of M1 deposits, grouped according to their position in the month, to the average of all weekly values. The first week of the month was defined as the week that contained the payment date for social security disbursements, which have a strong impact on individual checking deposits. Due in part to these payments, deposit levels during the first two weeks of the month are generally about 10 percent above the overall average level. During the third and fourth weeks deposits fall sharply to a point about 20 percent below average reflecting the recurring cycle of monthly bills. In the fifth week (which contains many of the same weekly observations as week one) deposit balances are rebuilt.[11]

The weekly forecast of M1 deposits is further disaggregated into separate forecasts for demand deposits and NOW accounts. The intra-monthly patterns for demand deposits and NOW accounts are very similar, although the NOW account data tend to be more stable. NOWs do not vary as much as demand deposits from their average level (represented in Chart 2 by the index value 1.0). This is not surprising since NOW accounts presumably contain a greater proportion of deposits not used for transactions purposes but held as savings.

Finally, the forecasts of both demand deposits and NOW accounts are broken down into separate projections for several different types of banks: large and small member commercial banks, nonmember commercial banks, and thrift institutions.[12] This disaggregation is needed to account for some variation in deposit patterns among the different groups. It also provides the Trading Desk with separate estimates of required reserves for these groups which together make up the projection of total required reserves. This information is used to help monitor the way different types of banks meet their reserve requirements over the course of the reserve maintenance period.

Non-M1 transactions deposits

In addition to the forecasts of M1 deposits, projections are also made for interbank and U.S. Government demand deposits since these accounts are subject to the same reserve requirements as M1 deposits. Interbank deposits are defined as demand deposits due to commercial banks less demand deposits due from commercial banks. These are balances used by banks for various clearing purposes. Large commercial banks tend to have net positive interbank deposits (*i.e.,* amounts due to banks exceed amounts due from banks) reflecting their position as correspondent banks for many smaller depository institutions, while small commercial banks and thrift institutions generally have net negative interbank deposits. Because interbank deposits have shown little overall trend in recent years, the forecasts tend to emphasize the seasonal variations in the weekly data, which exhibit a pronounced sawtooth pattern.

U.S. Government demand deposits reflect taxes collected and held temporarily by commercial banks for the Federal Government. On the day following collection these deposits are either remitted to the Federal Reserve for deposit to the Treasury's account or are invested in an interest-bearing account at the collecting bank The latter accounts (known as Treasury tax and loan note accounts) are exempt from reserve requirements. Therefore, the focus for purposes of estimating required reserves is on the flow of tax receipts which gives rise to an essentially overnight level of demand deposits.

The pattern of Treasury tax collections and, hence, U.S. Government demand deposits is largely determined by the payment dates for different types of Federal taxes. Thus, there are noticeable peaks in Government deposits when large amounts of individual and/or corporate income taxes are due, particularly in April, June, September, and December. The forecasting procedure exploits this relationship by using regression equations that relate weekly movements in Government deposits to the volume of Treasury tax collections. Estimates of Treasury tax receipts are made as part of the procedures for forecasting the Treasury's cash balance with the Federal Reserve (described in detail in Section IV). These tax forecasts are used as inputs to the equations that generate forecasts of Government deposits for the different categories of commercial banks. Judgmental adjustments are frequently made to these estimates to account for the equations' past forecasting record.

Reserve ratios

The final step in forecasting required reserves on transactions accounts is to apply the appropriate reserve ratio to the projected levels of transactions deposits. The average reserve ratio on transactions deposits for all banks is cur-

[11] The index numbers presented here represent the average pattern for all months from January 1981 to December 1985 The pattern for certain months is quite different from the overall average For example, M1 deposits generally fall throughout most of January, and in April the early month build-up continues through the April 15th payment date for individual income taxes

[12] The term "member" refers to membership in the Federal Reserve System Large member commercial banks are those that had domestic assets greater than $750 million as of December 31, 1977 About 200 banks are in the large bank category All other member commercial banks are classified as small

rently about 8 percent.[13] This figure reflects the structure of reserve requirements specified by the Monetary Control Act of 1980 (Footnote 9). In particular, nonmember commercial banks and thrift institutions are not yet required to maintain the full amount of reserve requirements. For these institutions, reserve requirements are being phased in over an eight-year period ending in September 1987.

Estimates of the average reserve ratio are based on a positive relationship between the average ratio and the level of transactions deposits. As deposits rise during the year, an increasing proportion is subject to the 12 percent reserve requirement on balances greater than $31.7 million. With more deposits subject to the 12 percent marginal ratio, the average ratio increases.[14] This relationship is expressed in formulas that relate the change in the average reserve ratio to the change in transactions deposits.

To account for distinctions in reserve requirements among different groups of banks, separate estimates are made of the average reserve ratio for each of the bank categories described earlier. The separate forecasts of transactions deposits (both M1 and non-M1) are summed for each group and multiplied by the applicable ratio to derive the forecasts of required reserves on transactions accounts. These forecasts are then combined with the known or estimated values for required reserves on nontransactions accounts to produce the forecast of total required reserves for each bank category.[15] The forecast of required reserves for the banking system as a whole is equal to the sum of the estimates for the individual groups. This is the forecast of RR in equation (8) in Section I.

Besides required reserves, banks' demand for total reserves also includes some amount of excess reserves. Therefore, a forecast of excess reserves must also be made in order to project the overall demand for reserves. The next section briefly explains why banks hold excess reserves and then describes the technique for forecasting them.

III. The demand for excess reserves

Banks hold excess reserves to ensure meeting their reserve requirements over a maintenance period and to avoid an overnight overdraft of their reserve account at the Federal Reserve. Thus, the demand for excess reserves is essentially precautionary in nature.[16] The flows through any individual bank's reserve account are quite uncertain and variable as customers deposit and withdraw funds. As a result, a bank can only estimate what its reserve account balance at the end of each day will be. Similarly, under CRR a bank does not know its level of required reserves until after the reserve maintenance period is complete or almost complete. If a bank misjudges its reserve position so that it has insufficient reserves to meet its average requirement for the maintenance period, called a reserve deficiency, it may be subject to penalties by the Federal Reserve. In addition, a bank must hold enough reserves by the end of each day to cover its daily reserve outflows; otherwise an overnight overdraft is incurred, which is also subject to penalties.[17] Therefore a bank's excess reserves provide a buffer against both reserve deficiencies and overdrafts. A larger buffer lessens the need for close monitoring of daily deposit flows and the resulting reserve balance. But because reserve balances earn no interest income, there is also an incentive to minimize excess reserve holdings. Overall, a bank's demand for excess reserves will reflect a balance between foregone interest income and monitoring costs, while insuring that its reserve obligations are met.

During the 1970s excess reserves remained relatively constant at about $200 million (Chart 3). Since late 1980 and the implementation of the Monetary Control Act (MCA), a basic uptrend has occurred, with excess reserves averaging $830 million during 1985. The MCA contributed to this uptrend by widening the range of institutions subject to reserve requirements and establishing new reserve ratios for all banks.

As reserve requirements for nonmember commercial banks and thrift institutions were gradually phased in under the MCA, their excess reserve holdings were counted for the first time. Also, the MCA gave nonmember institutions access to Federal Reserve services. To take advantage of this, many nonmembers opened accounts at Reserve Banks (even when they could meet reserve requirements with vault cash), and over time the activity level of these accounts has grown, further increasing average excess reserve holdings.

At the same time, the MCA reduced member bank reserve requirements. This change automatically raised excess reserves unless banks took active steps to reduce their

[13] This figure applies to domestic commercial banks, thrift institutions, and credit unions that report deposit data on a weekly basis and are subject to contemporaneous reserve requirements on transactions accounts

[14] To prevent this process from continuing uninterrupted, the Monetary Control Act specified that the amount of transactions deposits subject to the 3 percent reserve requirement be modified at the start of each year by 80 percent of the percentage increase in transactions deposits held by all banks as of the prior June 30 Similarly, the amount of reservable liabilities subject to the zero percent reserve requirement is adjusted each year by 80 percent of the percentage increase in total reservable liabilities of all banks as of the prior June 30 This effectively reduces the average reserve ratio

[15] The forecasts of required reserves are generally made for at least three reserve maintenance periods For the current period required reserves on nontransactions accounts are known since they are based on lagged values of the underlying deposits For future periods they are estimated based on forecasts of these deposits

[16] For more detailed descriptions of excess reserves behavior, see articles by David Beek, "Excess Reserves and Reserve Targeting," this *Quarterly Review* (Autumn 1981), pages 15-22, and by Kausar Hamdani, "CRR and Excess Reserves An Early Appraisal," this *Quarterly Review* (Autumn 1984), pages 16-23

[17] As of March 1986, increased attention is also being paid to intraday (called daylight) overdrafts It is still too soon to tell how and whether the demand for excess reserves will be affected

average reserve balances. Some banks, however, were not able to reduce their reserve balances because these accounts were already at the minimum levels needed for routine clearing. In other words, a further lowering of the average balance would have increased the risk of incurring an overnight reserve overdraft In other cases, banks simply permitted their excess reserve balances to rise because they did not find it cost-effective to manage reserve balances more actively even when the balances were not always necessary for clearing purposes

Other regulatory changes have also tended to raise excess reserve holdings for similar reasons. An example is the Garn-St Germain Act of 1982, which exempted each bank's first $2 million of reservable liabilities from reserve requirements This exemption was raised in stages to the current level of $2 6 million in 1986. Here again, excess reserves were raised because the exemption lowered required reserves of some banks below the minimum level of reserve balances thought necessary for general clearing purposes, while other institutions simply allowed the reductions of their requirements to show up as excess reserves

Forecasting excess reserves

Forecasting excess reserves requires taking account of not only the longer-run trend described above, but also some special factors that affect excess reserves from period to period. Accordingly, projections of the demand for excess reserves are made with the help of a regression equation that includes variables that capture both the long- and short-run influences This section presents only a brief nontechnical description of the variables used in the equation. Those readers who desire more technical details are referred to the articles cited in Footnote 16

One of the more important variables for estimating the demand for excess reserves is a moving average of excess reserves over the previous three reserve maintenance periods (six weeks). This variable captures not only the trend in excess reserves, but also the demand for excess reserves by the many banks that adjust their reserve balances slowly when some unexpected factor causes them to have more or less excess reserves than desired. This slow adjustment process probably reflects the high costs of reserve management for smaller institutions.

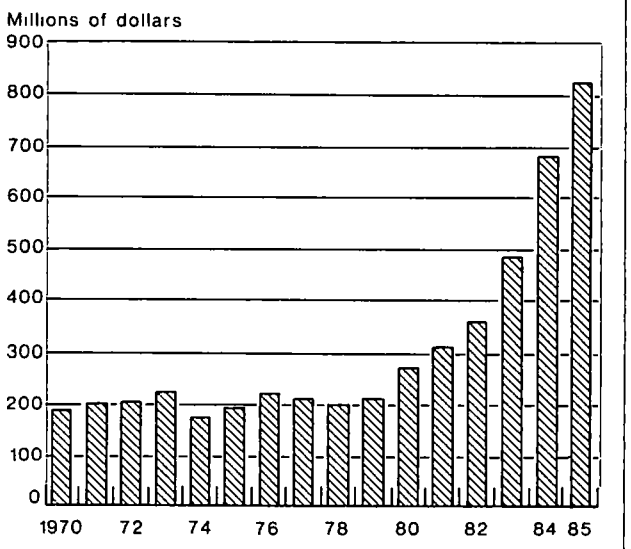
The effect of on-going regulatory changes such as the MCA and Garn-St Germain Act on the longer-run demand for excess reserves is measured by another variable These regulatory changes affect bank reserve requirements in ways that can be estimated in advance, and the variable used in the regression equation is the net cumulative change in total required reserves due to such regulatory changes. Reductions of reserve requirements typically result in higher excess reserves for reasons described earlier, and this variable captures that influence

Short-term fluctuations in excess reserves are associat-

Chart 3

Excess Reserves

Average annual levels

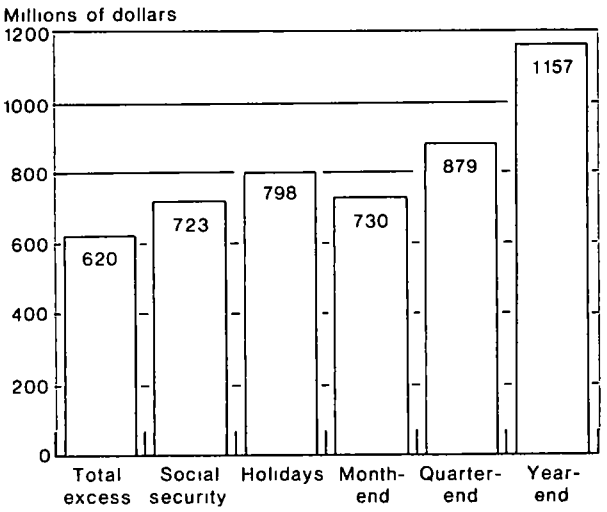


Source Board of Governors of the Federal Reserve System

Chart 4

Seasonal Influences on Excess Reserves

Three-year averages 1983-85



Source Federal Reserve Bank of New York staff estimates

ed with various calendar-related events, such as social security disbursements and bank holidays. Maintenance periods including these events typically show above average excess reserves. For example, from 1983 through 1985, periods containing social security disbursements averaged almost $100 million higher than otherwise (Chart 4).[18] These payments tend to distribute reserves toward the smaller institutions that are not aggressive reserves managers. Similarly, excess balances were higher than average (by about $100 million) at the end of the month, and at the ends of the second and third calendar quarters (by $260 million). At the end of the year, however, excess reserve balances were almost double the average level. Seasonal influences of such substantial size occur because at these calendar dates deposit flows are typically larger and more volatile, making it more difficult for banks to estimate and manage their accounts at the Federal Reserve accurately. As a result, bank reserve managers seem to build up excess reserve positions on a contingency basis to ensure meeting their reserve obligations. Some institutions may also engage in a certain amount of "window dressing" at the quarter-end by building up their liquid balances to appear conservative on published reports. In addition, bank holidays have been associated with higher than average holdings (by about $180 million), probably because of added uncertainty about when payments will be received or sent. Moreover, a misjudgment the day before a holiday has extra costs since that day's reserve balance receives two days weight when computing the average balance for the maintenance period.[19] In the regression equation the various calendar events are accounted for by dummy variables.

The final variable in the equation is the net reserve carryover of large member banks. If a bank ends a period with a reserve surplus, the carryover privilege allows the bank to carry forward into the next maintenance period a certain portion of its surplus to be applied toward a deficiency in the following period. As a result, surpluses are not entirely wasted. Similarly, a certain sized deficiency can be incurred by a bank without eliciting automatic penalties since it may be covered by a surplus in the following period.[20] The reserve carryover privilege in effect allows banks some flexibility in timing the acquisition of reserves.

Depending on whether a bank's net carryover is positive or negative, it may hold lower or higher reserve balances which will show up as lower or higher excess reserves. For example, a bank with a positive carryover of $100 thousand may incur a reserve balance deficiency of at least $100 thousand without penalty.[21] As a result, the bank will allow its reserve balance to average somewhat lower, and with required reserves unchanged, its excess reserves will also be lower. Of course, efficient use of the carryover privilege requires active reserve management by a bank since it entails close monitoring and adjustment of its reserve account. Therefore, only the net carryover of large member banks is included in the equation since they are usually the most active reserve managers and the most likely to use this privilege fully. In fact, for these banks the effect of carryover on excess reserves is virtually a dollar-for-dollar offset.

Each week as new data for the moving-average and carryover variables are received, the regression equation is reestimated and a forecast of excess reserves is generated. Referring back to the overview section, this forecast would be used to evaluate the allowance for excess reserves used in constructing the nonborrowed reserve path, $\overset{*}{NBR}$. The next step is to forecast the potential supply of nonborrowed reserves, $\overset{\Delta}{NBR}$.

IV. The supply of nonborrowed reserves

This section describes the behavior of the technical factors that affect the supply of nonborrowed reserves, and procedures for projecting the individual reserve factors. The following introduction shows how these factors — the RF in equation (3)—can be derived from some simple accounting identities using the Federal Reserve's balance sheet.

At the broadest level, total Federal Reserve assets (A) are equal to total liabilities (L).

$$(10)\quad A = L$$

Reserve accounts of member banks are, of course, only one liability of the Federal Reserve, and thus total assets are equal to reserve accounts (RA) plus all other liabilities (OL).

$$(11)\quad A = RA + OL$$

By rearranging terms, reserve accounts can be set equal to total assets less other liabilities.

$$(12)\quad A - OL = RA$$

Borrowings from the discount window (BR) can then be subtracted from both sides of the equation leaving other

[18] The values in Chart 4 were computed by taking the average, for 1983 through 1985, of excess reserves held during reserve maintenance periods containing the calendar event specified

[19] If the holiday occurs on a Friday or a Monday, that reserve balance counts for four days in computing the maintenance period average

[20] However, negative carryovers are not permitted for two or more consecutive periods A positive carryover not used in the following period is lost

[21] The potential effects could be even larger A bank's maximum allowable reserve carryover is the greater of either $25 thousand or approximately 2 percent of its average reserve requirement Therefore, a bank with a maximum allowable carryover of say $200 thousand and with a positive carryover of $100 thousand could incur without penalty a reserve balance deficiency of up to $300 thousand in the next period That is, $100 thousand would use the positive carryover and $200 thousand would be the maximum allowable carryover deficiency

assets (OA) less other liabilities on the left side and nonborrowed reserve accounts (NRA) on the right side

(13) $OA - OL = NRA$

However, nonborrowed reserve accounts at the Federal Reserve (NRA) are not equal to the total supply of nonborrowed reserves (NBR) because the reserves that banks are required to hold against their deposit liabilities may be held as reserve balances or as vault cash. Therefore, to obtain total nonborrowed reserves, vault cash used to satisfy reserve requirements (VC) must be added to both sides of the equation.

(14) $OA - OL + VC = NRA + VC = NBR$

The left side of this equation can be broken down further to separate changes in the System's securities portfolio from those assets and liabilities which are beyond the control of the Federal Reserve The change in total nonborrowed reserves is thus equal to reserves supplied through open market operations (OMO), plus the changes in all remaining assets (ARA) and vault cash, minus the change in other liabilities.

(15) $OMO + [\Delta ARA + \Delta VC - \Delta OL] = \Delta NBR$

Combining the items within brackets on the left side gives the familiar identity for the change in nonborrowed reserves presented as equation (3) in Section I

(3) $OMO + \Delta RF = \Delta NBR$

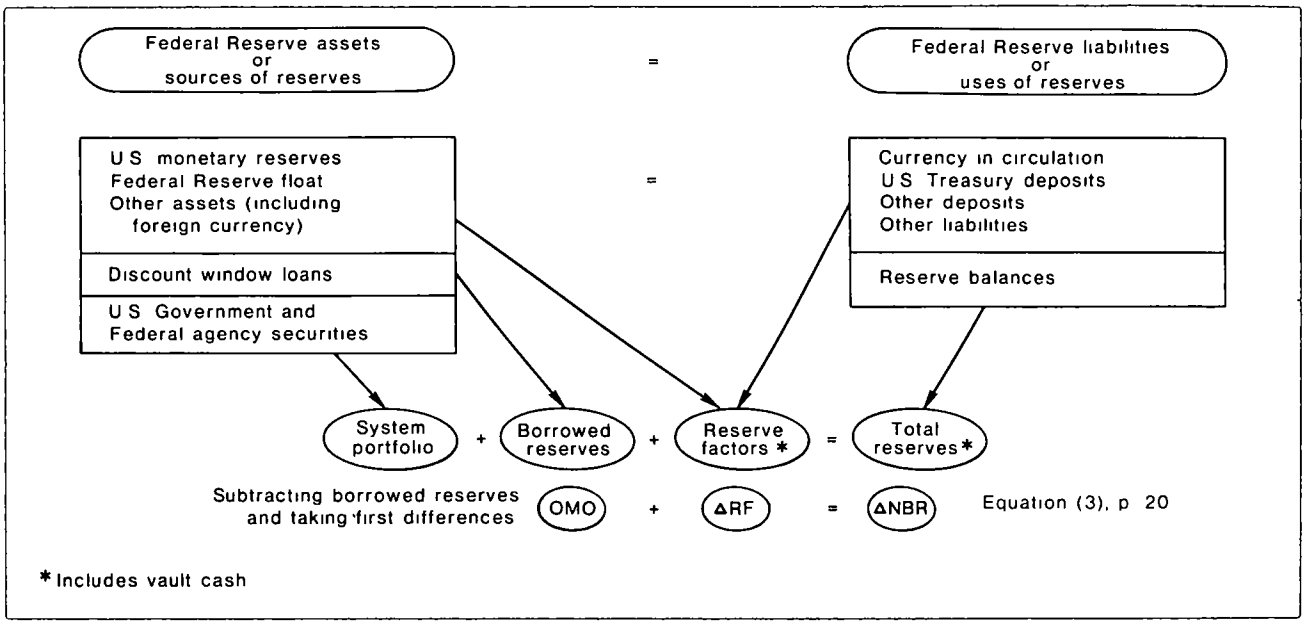
Therefore, these accounting identities show that projections of RF, which influence the supply of nonborrowed reserves, can be derived from separate forecasts of the individual asset and liability items on the Federal Reserve's balance sheet plus some non-balance sheet items, notably vault cash [22]

This description employs the concept of "sources and uses" of reserve funds where Federal Reserve assets are viewed as sources of funds because increases in them provide reserves to the banking system and decreases absorb

[22] Banks may satisfy all or part of their reserve requirements during a given reserve maintenance period with vault cash held approximately two weeks earlier However, for those banks whose vault cash exceeds their reserve requirements, only the amount of vault cash equal to their reserve requirements (called applied vault cash) is included in the definition of total nonborrowed reserves That is, applied vault cash is the uncontrolled reserve factor noted above as VC The two-week time lag means that total vault cash holdings are known before the maintenance period begins Nevertheless, during the period the reported data for total vault cash must be adjusted by removing an estimate of vault cash not applied toward reserve requirements This is not known with certainty until total required reserves are calculated after the maintenance period ends

Chart 5

Factors Affecting the Supply of Bank Reserves



reserves Federal Reserve liabilities, in contrast, are viewed as competing uses of funds, and hence increases in them absorb reserves and declines provide reserves. Chart 5 presents a schematic overview of these relationships and how they lead to equation (3) [23]

The three most important contributors to the overall variability of RF are Federal Reserve float on the asset side, and currency in circulation and U.S. Treasury deposits on the liability side. The table (Columns 2-4) presents statistics on the weekly variability of these three factors individually over the past ten years and Column 1 shows the same information for all the reserve factors combined. The weekly instability of RF is important because in large part it determines the extent to which the Desk conducts open market operations for purely defensive purposes.[24] Furthermore, for several of the major components of RF, the accuracy and reliability of the forecasts has been related to changes in their volatility.

Treasury deposits seem to have exerted the greatest influence on the relative instability of RF over time. From 1976 to the early 1980s the variability of RF fell from over $2 billion per week to only $1 billion due to a sharp decline in the volatility of Treasury deposits, which more than offset increases in the weekly variability of float and currency in circulation Since the early 1980s Treasury deposits and currency have become somewhat more volatile, while float has become less volatile On balance, the overall variability of RF has increased to $1 7 billion per week in 1985, the highest value since the late 1970s More details on these changes are provided in the following sections

Federal Reserve float

Federal Reserve float, a source of bank reserves (Chart 5), arises primarily from the Federal Reserve's check clearing activities Float is created when reserve credit is given for checks deposited with the Federal Reserve according to time schedules that do not always reflect the time needed to collect payment for these items. Thus, increases in float provide reserves to the banking system and declines absorb reserves.

Historically, Federal Reserve float has been one of the more important reserve factors. Over the past decade float has varied from an annual level of $6.6 billion in 1979 to $0.8 billion in 1985 (table). Between 1976 and 1979, the level of float more than doubled, in part because of increases in check volume During this period the total dollar volume of checks handled by the Federal Reserve increased from $4.6 to $9.0 trillion Higher float levels were also attributable to a tendency by some users of Federal Reserve services to write checks drawn on banks located in remote areas of the country. This method of remote disbursement benefited users by increasing the length of time it took for checks to clear.

From 1979 to 1985 float declined steadily, due primarily to initiatives taken by the Federal Reserve and as a consequence of the Monetary Control Act of 1980 In the late 1970s, the Board of Governors called for the elimination of

23 In Chart 5 various Federal Reserve assets and liabilities have been combined in order to simplify the presentation More detailed descriptions of these items can be found in *The Federal Reserve System Purposes and Functions*, Board of Governors of the Federal Reserve System (1984) and *Statfacts Understanding Federal Reserve Statistical Reports*, Federal Reserve Bank of New York (November 1981)

24 Fluctuations in required and excess reserves are, of course, also important During 1985 the average absolute changes in required and excess reserves (measured over two-week reserve maintenance periods) were $0 7 billion and $0 2 billion, respectively

Reserve Factors-Weekly Variability and Average Levels*

In billions of dollars

Year	(1) All reserve factors (RF) † |Δ̄|	(2) Federal Reserve float Level	(2) Federal Reserve float |Δ̄|	(3) Currency in circulation Level	(3) Currency in circulation |Δ̄|	(4) U S Treasury deposits Level	(4) U S Treasury deposits |Δ̄|
1976	2 1	2 6	0 4	88.4	0 4	7 3	2 0
1977	2 0	3 7	0 5	96 5	0 5	7 4	2 1
1978	1 8	5 5	1 0	106 1	0 5	8 0	1 7
1979	1 3	6 6	1 2	116 6	0 5	3 2	0 4
1980	1 0	4 6	1 0	127 5	0 6	3 0	0.6
1981	1 0	3 3	0 7	137 5	0 7	3 2	0 4
1982	1 3	2 5	0 6	147 4	0 8	3 8	0 8
1983	1 3	1 8	0 5	160 7	0.7	4 1	0 9
1984	1 5	0 8	0 5	173 9	0 8	4 4	1 2
1985	1 7	0 8	0.4	185 5	0.9	4 1	1 1

* Variability is measured by the average absolute change, \|Δ̄\|, in the indicated series calculated over one-week periods For 1985 the comparable figures measured over two-week reserve maintenance periods were all reserve factors $2 0, Federal Reserve float $0 3, currency in circulation $1 2, and U.S Treasury deposits $1 4

† Excludes extended credit borrowing

remote disbursement activities, and efforts were made within the System to lower float through improved check monitoring and processing procedures. The Monetary Control Act required the Federal Reserve to begin levying special charges for float and float pricing was instituted during 1983. During the 1979-85 period, the Federal Reserve's check volume increased only slightly, rising to $9.6 trillion in 1985, because banks made more use of alternative check processing services The combined effect of these forces was to reduce float to an annual level of $0 8 billion in 1985 And as float levels declined, so did their volatility. The average absolute weekly change in float dropped from $1 2 billion in 1979 to $0.4 billion in 1985 (table).[25]

The level of float is affected by seasonal variations in business activity and in particular by bank holidays and random disruptions of the check clearing process The yearly seasonal pattern for float is roughly U-shaped, but with lower volatility in recent years this pattern is less pronounced (Chart 6). Still, float tends to rise in November and December as check volume increases around the holidays, and to remain high through the winter months when transportation delays are most severe. For the remainder of the year float remains relatively flat

The initial forecasts of Federal Reserve float are based on estimates of the overall trend and the rough monthly seasonal patterns. These projections are then translated into expected weekly and daily patterns The forecasts are updated daily with data on the prior day's float level from the Federal Reserve balance sheet, and any advance information on the potential impact of random events on the level of float. For example, each day the projections staff is in touch with the Interdistrict Transportation Service (ITS) based at the Federal Reserve Bank of Boston, which monitors the network of air carriers delivering checks between Federal Reserve districts. ITS provides estimates on the dollar amount of float created by late check deliveries, which are incorporated into the daily float projection District Reserve banks also provide information about delays in check processing or equipment failures that could lead to float in excess of $100 million [26]

Another aspect of float forecasting is incorporating corrections for errors that arise in processing various types of transactions through bank reserve accounts For example, over-crediting a bank's reserve account for checks received can occur in the check clearing process. When these errors are discovered, corrections referred to as "as of adjustments" are made The amount of the adjustment is calculated "as of" the point in time when the error occurred. These adjustments are not a Federal Reserve balance sheet item but must be included in the forecast of the supply of nonborrowed reserves because they affect the calculation of whether a bank has met its reserve requirement At times these adjustments can be quite large—several billion dollars, in the case of a severe disruption of the wire transfer system. However, they are not a great source of uncertainty, since data on the aggregate amount of these adjustments processed each day are available the next morning, and in addition the projections staff is alerted by district Reserve banks when "as of adjustments" processed during the day sum to $100 million or more.

Currency in circulation

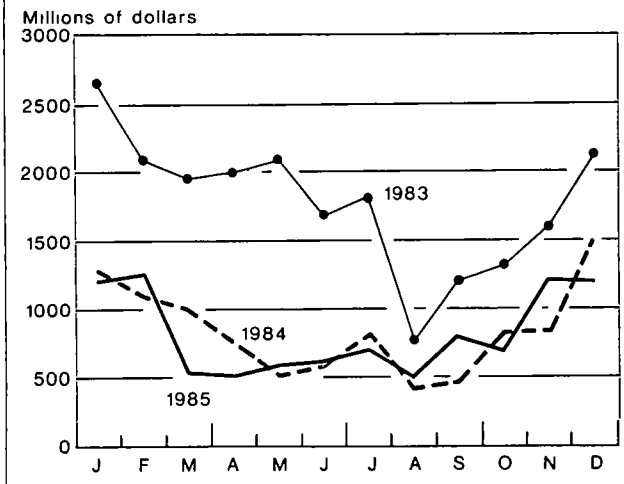
Currency in circulation is one of the competing uses of reserve funds (Chart 5) [27] A bank requiring currency to satisfy the needs of its customers obtains it from the local Reserve bank and pays with a debit to its reserve account When the public's demand for currency falls and currency is returned to the Federal Reserve, banks' reserve accounts are credited Thus, increases in currency in circulation absorb bank reserves, and decreases in currency provide reserves [28]

25 For a more detailed description of float over the past decade see John E Young, "The Rise and Fall of Federal Reserve Float," *Economic Review*, Federal Reserve Bank of Kansas City (February 1986), pages 28-38

Chart 6

Federal Reserve Float

Monthly average levels 1983-85



Source Board of Governors of the Federal Reserve System

26 For earlier work on the causes of float see Irving Auerbach, "Forcasting Float," *Essays in Money and Credit*, Federal Reserve Bank of New York (December 1964), pages 7-12 and Arline Hoel, "A Primer on Federal Reserve Float," *Monthly Review*, Federal Reserve Bank of New York (October 1975), pages 245-253

27 Currency in circulation as defined here includes all paper money issued by the Federal Reserve and coin issued by the Treasury, held by the public or in bank vaults It excludes currency held by the Reserve Banks and the Treasury

28 To the extent that banks hold some amount of currency as vault cash, *(p 30)*

Of all the reserve factors, currency in circulation has the greatest long-run impact on the supply of nonborrowed reserves. Currency in circulation has more than doubled in the past decade, increasing at a rate of about $11 billion per year (table). By contrast, float and Treasury deposits have been relatively stable in the past few years. Increased demand for currency results in a persistent drain on the supply of nonborrowed reserves, and an important share of open market operations over the year is directed toward meeting this reserve need.

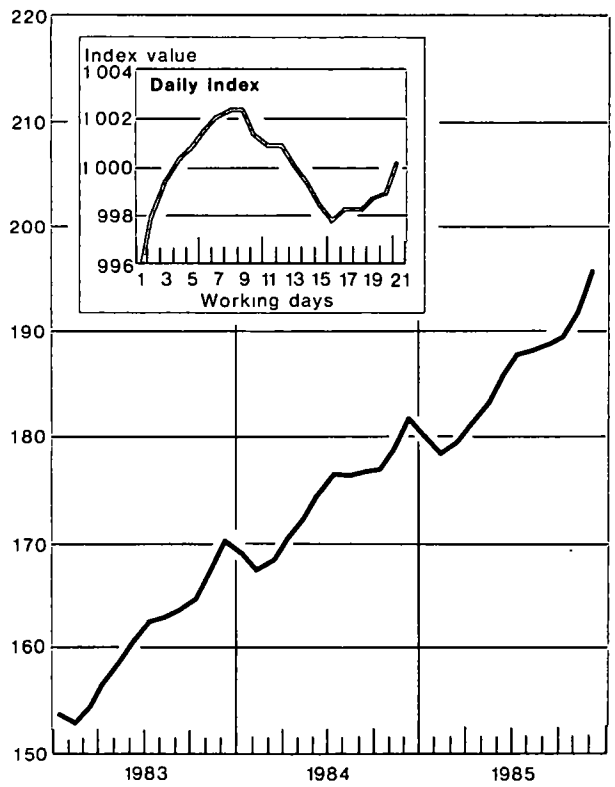
Along with the growth in the level of currency, there has been a commensurate increase in its variability from an average absolute weekly change of about $0.5 billion in the late 1970s to nearly $1.0 billion in 1985. These figures reflect the upward trend in currency, as well as pronounced seasonal movements. The Desk's defensive operations respond to these short-run swings in currency demand, as needed. In this way, the Federal Reserve insures an orderly expansion or contraction in the volume of currency in circulation to meet the seasonal and cyclical needs in the general economy, thus providing an elastic currency supply as envisioned by the Federal Reserve Act of 1913

Footnote 28, *continued*
the impact of these transactions on total bank reserves is, of course, offset However, since there is a lag of several weeks between when vault cash is held and when these funds are used to satisfy reserve requirements, the offset occurs in a future reserve maintenance period

Chart 7

Currency in Circulation

Monthly average levels 1983-85



Source Board of Governors of the Federal Reserve System

The major patterns in currency in circulation are highlighted in Chart 7, which shows monthly average data over the last three years and a sketch of currency behavior during an average month. The monthly data reveal the steady upward trend in currency over the year and the strong seasonal patterns particularly around holidays A clear pattern is the build-up in demand for currency around Thanksgiving and Christmas followed by a sharp return flow of currency from the public to the Federal Reserve over the first two months of the year

The intra-monthly pattern in currency demand is shown in the insert to Chart 7 These index numbers are ratios of the daily levels of currency in circulation during 1985, grouped according to working days in the month, to the average of all daily values They show that, like M1 deposits (Chart 2), currency in circulation rises during the first half of the month as end-of-month paychecks and social security payments are cashed Individuals' routine monthly disbursements cause currency holdings to decline over the second half of the month, but by about the twentieth working day currency balances are again being rebuilt.

For forecasting purposes it is first necessary to get a general idea of the public's demand for currency given overall economic conditions Thus, a conventional demand for currency equation is used to capture long-term trends in currency growth over the business cycle. This regression equation projects quarterly levels of currency based on recent trends in consumer spending and other economic variables. These projections are judgmentally adjusted according to the equation's performance over time The final adjusted forecasts of currency on a quarterly basis are used to guide the projections for shorter time periods.

Since daily forecasts of the reserve factors are prepared for the Desk, a second set of currency equations is used to capture seasonal patterns in daily currency data These equations use two types of variables. The first type is sets of sine and cosine curves designed to mirror the observed patterns in currency, which are repeated over the course of a week, a month, or a year The second type is sets of dummy variables structured to capture the effects of holidays. Together these variables give an outline of the dai-

ly movements in currency, which are then judgmentally adjusted to form weekly, monthly, and ultimately quarterly forecasts constrained by the results from the behavioral equation described above. In this way the daily currency forecasts contain cyclical as well as seasonal elements, and the longer-run forecasts of currency demand can be reassessed as new daily data become available [29]

U.S. Treasury deposits

U.S. Treasury deposits are a liability of the Federal Reserve and a use of reserve funds (Chart 5). The Treasury uses this account to make payments by check and electronic funds transfer for all types of Federal spending. As these payments are made, private bank accounts and consequently bank reserve accounts are credited, and the Treasury's Federal Reserve deposit is charged. The flow of government tax revenues has just the opposite effect, raising Treasury deposits and absorbing bank reserves.

While the Treasury uses its Federal Reserve account primarily for payments, it also maintains accounts at commercial banks, referred to as Treasury tax and loan (TT&L) accounts, which are used to facilitate tax collections and to hold Treasury funds in interest bearing form until needed [30] As noted earlier in the section on non-M1 deposits, taxes collected by commercial banks are generally held overnight as reservable demand deposits and are then either transferred to the Treasury's account at the Federal Reserve or invested in Treasury tax and loan note accounts. The TT&L note accounts earn interest at a rate one-quarter percentage point below the average rate on Federal funds The Treasury's account at the Federal Reserve is replenished to cover daily expenditures by transfers of funds (referred to as "calls") from the TT&L note accounts These calls absorb bank reserves. At other times surplus funds in the Treasury's Federal Reserve account are transferred back to commercial banks. These transfers (referred to as "direct investments") increase bank reserves

Over the past ten years U.S. Treasury deposits have been a major contributing factor to the overall variability of RF (table) During the 1976-78 period the Treasury held most of its funds with the Federal Reserve and kept its balances at commercial banks at a level which compensated them for services performed for the Treasury This policy led to average Treasury deposits at the Federal Reserve of about $7 5 billion, and variability of about $2 0 billion per week. These wide swings in Treasury deposits had a significant impact on the Desk's defensive operations.[31]

In 1978 the present system of interest bearing TT&L accounts was introduced As a result, the Treasury sharply reduced its deposits with the Federal Reserve and shifted these funds back to commercial banks. It aimed to keep an essentially steady level of working balances at the Federal Reserve, generally around $3 billion. This change in practices led to an immediate decline in the variability of the Treasury's Federal Reserve account to about $0 5 billion per week. In recent years, the aim has not changed but the average level of the Treasury's account has increased to about $4 billion and the variability has risen to about $1 billion per week. These changes reflect growth in the Treasury's overall cash position, particularly during periods of heavy tax inflows. The largest swings in Treasury deposits have appeared around the payment dates for individual and corporate income taxes (Chart 8).

Forecasting the daily level of Treasury deposits at the Federal Reserve begins with monthly projections of U.S. Government receipts, expenditures, and debt financing. The monthly projections are broken down into daily

[29] For earlier work on forecasting currency , see Irving Auerbach, "Forecasting Currency in Circulation," *Essays in Money and Credit,* Federal Reserve Bank of New York (December 1964), pages 13-18

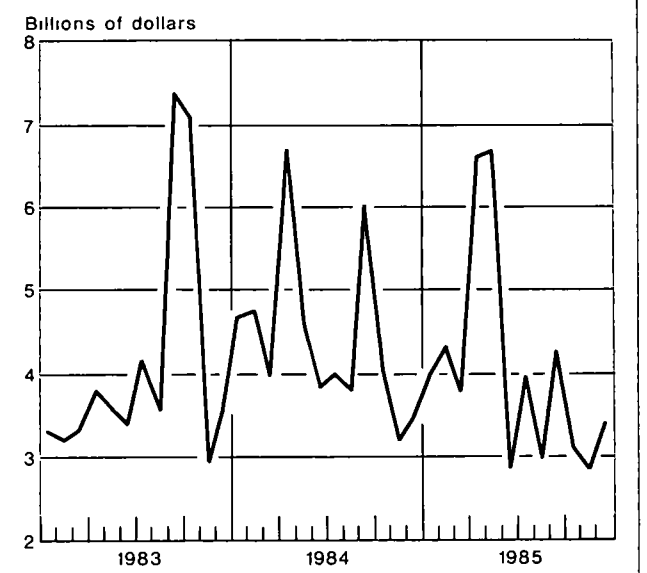
[30] The funds held in TT&L accounts primarily represent corporate and withheld income taxes These funds also include receipts from the sale of securities purchased at Treasury auctions

[31] For a more detailed discussion of the impact of Treasury deposits on defensive open market operations during this period, see Joan E Lovett, "Treasury Tax and Loan Accounts and Federal Reserve Open Market Operations," this *Quarterly Review* (Summer 1978), pages 41-46

Chart 8

Treasury Deposits at the Federal Reserve

Monthly average levels 1983-85



Source Board of Governors of the Federal Reserve System

forecasts following the patterns from earlier months that had a similar structure of daily dates. Approximately 30 individual receipt and expenditure categories are projected.[32] Each morning these projections are updated with new data provided by the Treasury on its Federal Reserve and TT&L deposits, as well as the individual receipt and expenditure items.

It is necessary to estimate not only total tax receipts but also whether they will be held in TT&L note accounts or at the Federal Reserve. Because TT&L note accounts must be backed by acceptable collateral, banks are only willing to hold a pre-determined amount of funds in these accounts. For the banking system as a whole these limits currently sum to about $23 billion. Tax receipts in excess of a bank's individual limit are transferred to the Treasury's deposit at the Federal Reserve. During periods of high tax receipts the daily amount of these transfers can be substantial, as much as several billion dollars. Estimates of these transfers are based on projections of total tax collections on a given day and an allowance for how close banks are to their note account limits.

Other reserve factors

Aside from float, currency in circulation, and U.S. Treasury deposits, there are several other factors that at times can also significantly influence the supply of nonborrowed reserves and must, therefore, be taken into account in the overall forecast. A brief description of these factors is given in this section.

Other deposits. In addition to banks and the U.S. Treasury, other types of financial institutions also maintain deposits with the Federal Reserve, such as Federal Government agencies (*e.g.,* the Federal National Mortgage Association), foreign central banks, and international organizations (*e.g.,* the World Bank). Since these deposits do not earn interest, they are held at relatively low levels. These accounts, like U.S. Treasury deposits, are liabilities of the Federal Reserve and a use of bank reserves (Chart 5). Thus, movements of funds through them have an inverse effect on the supply of nonborrowed reserves.

As with the other reserve factors, movements in these accounts are monitored on a daily basis. Data received each morning from the Foreign Operations and Accounting departments here at the Federal Reserve Bank of New York are used to adjust the daily forecasts. Longer term forecasts rely on historical moving averages of these series plus some allowance for known seasonal variations. For example, periodic increases in foreign central bank deposits occur around the middle and end of each month due to an increased volume of inter-country payments. Similarly, the deposits of certain Federal agencies tend to run higher than normal during periods when large interest payments or debt redemptions are due.

Foreign repurchase agreement (RP) pool. As noted above, foreign central banks hold a relatively low level of deposits with the Federal Reserve (about $200 to $300 million). On most days, however, the amount of funds that accumulates in these accounts is considerably greater than foreign central banks desire to hold there. These funds are pooled and invested in overnight repurchase agreements either with the Federal Reserve or in the market through government securities dealers.

Even though the foreign RP pool is not a Federal Reserve balance sheet item, it is treated in practice as a reserve factor because it affects the supply of nonborrowed reserves. If the pool is invested overnight in securities from the Federal Reserve's portfolio, bank reserves are absorbed because the funds that flow into foreign central bank accounts are not returned to the banking system. If, however, the foreign RP pool is invested overnight with government securities dealers, no net effect on bank reserves occurs. Such investments are referred to as customer-related RPs.

Forecasts of the supply of nonborrowed reserves include estimates of the foreign RP pool and routinely assume that it will be invested with the Federal Reserve. If, however, these funds are arranged as customer-related RPs, reserves would be supplied to the banking system relative to the original forecast.

Each morning the daily estimates of the foreign RP pool are updated with the latest information on flows of funds through foreign central bank accounts, while longer-term estimates attempt to capture the more regular intra-monthly variation in these accounts. Since the foreign RP pool can be quite large at times, it has an important impact on the reserve outlook. During 1985 the foreign RP pool averaged $3.8 billion, and its weekly variability, as measured by the average absolute change, was $0.4 billion.

Extended credit borrowing. In earlier sections, the supply of reserves provided to the banking system through the Federal Reserve discount window was pictured as a single homogeneous series (BR). In practice, such loans fall into one of three general classifications: adjustment credit, seasonal credit, and extended credit (extended credit as defined in Regulation A less its seasonal credit component). In conducting open market operations the Desk views the third category, extended credit borrowing (ECB), as one of the technical reserve factors. That is, in terms of equation (8), $\overline{BR}$ is defined as adjustment plus seasonal credit, and ECB is included in RF.

Extended credit borrowing is provided through two programs designed to assist depository institutions in meeting somewhat longer-term needs for funds. One program provides credit to institutions with special difficulties arising

[32] These categories appear in the U S Treasury's published *Daily Treasury Statement*

from exceptional circumstances or practices involving only that institution. Assistance in these cases is provided only when funds are not available from other sources. The second program is for situations where more general liquidity strains affect a broad range of institutions.

Over the past few years, ECB has varied over a fairly wide range from close to zero in late 1983 to a high of $7.0 billion in August 1984. During 1985 it averaged $0.7 billion. Such variability can have an important effect on the short-run supply of nonborrowed reserves, and hence projections of ECB are included along with all the other components of RF. The estimates of ECB are made with information gathered from the Board of Governors and district Reserve Banks.

Foreign currency. The Federal Reserve's holdings of foreign currency are included in the other assets category of the balance sheet and as such are considered a source of bank reserves (Chart 5). Changes in the level of foreign currency come about through foreign exchange intervention. The proceeds of intervention are normally divided equally between the Federal Reserve and the U.S. Treasury's Exchange Stabilization Fund (ESF). In both cases, bank reserve accounts are credited when the Federal Reserve purchases foreign currency and are debited as a result of Federal Reserve sales.[33]

To the extent that foreign exchange intervention by the Federal Reserve for its own account affects the supply of nonborrowed reserves in relation to the Desk's objective, it will be offset or "sterilized" through open market operations. That is, in terms of equation (8) a change in RF produced by Federal Reserve foreign currency transactions that is inconsistent with the path for NBR will be offset by OMO. Foreign exchange intervention for the ESF, however, is normally sterilized through a different channel. In the case of a foreign currency purchase for example, the ESF redeems special-issue Treasury securities to obtain dollars for intervention. When these securities are redeemed, funds are transferred from the Treasury's general account to its ESF account at the Federal Reserve. The ESF account is then charged and the reserve accounts of the sellers' banks are credited. On the Federal Reserve balance sheet this increase in bank reserves appears as the offsetting entry to the decline in Treasury deposits. The reserve increase is sterilized when the Treasury makes a call on the tax and loan note accounts to restore the general account to its initial level.

For forecasting purposes the Foreign Operations area provides daily information on the extent and timing of any foreign exchange activities. The reserve effect of foreign exchange transactions occurs when the transactions settle, usually two business days after the initial agreement. Thus, the Desk is informed in advance of any change in the supply of reserves from this source.

Summary

A broad range of economic and technical information is brought together from many sources to make the projections of the potential demand and supply of bank reserves for the Open Market Trading Desk. On the demand side, forecasts of the demand for required reserves are based primarily on projections of deposits included in the narrow definition of the money supply, M1 These forecasts are updated as official reports of deposits are submitted by banks to the Federal Reserve. Estimates of the demand for excess reserves reflect a variety of seasonal influences, as well as the effects of regulatory changes. Taken together the projections of required and excess reserves are used to help build a target path for nonborrowed reserves ($\overset{*}{NBR}$), calculated as the expected total demand for reserves less the Desk's assumption for borrowings from the discount window.

On the supply side the forecasts focus on the technical factors on the Federal Reserve's balance sheet, such as float, currency in circulation, and U.S. Treasury deposits. These estimates are revised daily by using the latest data on Federal Reserve assets and liabilities, and are combined to form a projection of the prospective supply of nonborrowed reserves ($\overset{\wedge}{NBR}$).

Thus, each day the Trading Desk receives an updated estimate of the need for defensive open market operations (expressed as $\overset{*}{NBR}$ less $\overset{\wedge}{NBR}$) the components of which are known with varying degrees of certainty. This forecast serves as a guide for Desk operations, but given the volatility of bank deposits and reserve factors, and the resulting risk of forecast error, it is a guide that is used cautiously.

John C. Partlan, Kausar Hamdani, and Kathleen M. Camilli

33 Other discussions on this topic include Anatol B Balbach, "The Mechanics of Intervention in Exchange Markets," Federal Reserve Bank of St Louis *Review,* Volume 60 (February 1978), pages 2-7 and Roger M Kubarych, "Monetary Effects of Federal Reserve Swaps," this *Quarterly Review* (Winter 1977-78), pages 19-21