

# Comparing Central Banks' Rulebooks

by E. J. Stevens

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## Introduction

**B**anks' account relationships with their Federal Reserve Banks are changing because account regulations are changing. The Board of Governors of the Federal Reserve System began a program in 1986 to limit banks' use of daylight overdrafts, broadened the program in 1991, and beginning in 1994 will charge a fee for daylight overdrafts that exceed certain minimum amounts. The Board also reduced reserve requirements to zero on nontransactions deposits in 1990 and cut the highest reserve requirement on transactions deposits from 12 percent to 10 percent in 1992.

The purpose of this article is to examine how major changes in our central bank's rulebook might affect Federal Reserve operations and U.S. monetary and payments institutions. To this end, I contrast Federal Reserve overdraft and reserve requirement regulations — and the institutional setting in which they are administered — with analogous rules and institutional settings at three of the world's other leading central banks: the Deutsche Bundesbank, the Bank of Japan, and the Bank of England.

Do the account regulations in a central bank's rulebook matter? Central banks in industrialized countries all perform roughly the same functions,

centered on controlling the issuance of base money and providing safe, final settlement of interbank payments. They do so, however, with apparently quite different regulations governing the accounts of their customer banks. Some central banks allow daylight overdrafts while others do not; some have no reserve requirements; and some are more ready to lend than others.

Of course, some central banks may perform better than others, with less inflation or more safety in their payments systems. Jürg Niehans has observed that "...the effects and the effectiveness of central bank policy depend to a large extent on technical and institutional details that vary from one country to another and in the course of time." (Niehans [1978], p. 263) Surely, however, major differences in performance have more to do with a central bank's objectives, and with its institutional and political will to achieve them, than with its rulebook of account regulations.

A central bank's rulebook is important, nonetheless. In addition to any costs imposed on banks, account regulations influence the operating techniques and involvement of the central bank in the money market. With unaltered objectives, substantial changes in the Federal Reserve's rulebook would require associated modifications in both

its operating practices and the nation's payments institutions.

The curse of considering many questions labeled as "central banking" is the absence of an agreed-upon frame of reference within which to conduct the analysis. The grand perspective of monetary theory is too broad for this purpose; it says little about the mundane details of central bank operations. Likewise, marginal analysis of an individual bank's decisions under a particular set of central bank rules is too narrow; it fails to capture systemic implications of the relevant market institutions.

Comparison with other central banks is used here as a way to gain perspective on the Federal Reserve's rulebook. With or without daylight overdrafts, and with high, low, or no reserve requirements, each central bank is able to perform similar day-to-day monetary and payments system functions. Differences in rules can be associated with differences both in market institutions and in the way a central bank interacts with financial markets and the banking system.

The remainder of the article is divided into five sections. The first briefly reviews the unique monetary and payments system functions of any central bank. The next section compares the role of each of the four central banks considered here in financing customer banks' clearing imbalances during the course of a day.

Two sections then contrast the four central banks' techniques for maintaining policy-intended supplies of customer banks' balances and the monetary base. These practices involve central bank operations that monetize and demonetize debt (covered in section III). Some central banks avoid lending directly to individual banks, tending instead to use open-market operations in securities to adjust the aggregate supply of base money and relying on markets to allocate funds among banks. Others are more willing to bypass credit markets by lending directly to individual banks when adjusting aggregate supply.

The level and averaging features of reserve requirements (covered in section IV) influence the extent to which a central bank must respond to daily shocks to the aggregate supply of base money. Some rely more heavily than others on customer banks to absorb these shocks. The concluding section summarizes the international comparisons and extracts some apparent lessons about changing the Federal Reserve's rulebook.

## I. Monetary and Payments Functions of a Central Bank

As the monetary authority, a modern central bank controls the supply of "outside," or base, money. This anchors the price level in the long run while allowing a central bank to respond to variations in the economy over the business cycle and to liquidity needs in the short run.

As the banker for commercial and other banks operating in its country, a central bank is able to settle interbank payments because it is the unique common site of banks' deposit accounts: A simple bookkeeping transfer from one account to another can settle payments involving any two banks. In the same way, a central bank is able to settle payments to and from its government or official foreign institutions that hold deposit accounts with it. In short, the central banks of most industrialized countries control the aggregate supply of base money while transferring ownership of banks' base-money balances to settle the daily clearing of payments.

Monetary policy deals with the growth rate of the monetary base. Raising or lowering this rate has the immediate effect of, or is brought about by, changing the interest rate at which banks can acquire very short-run funding of their accounts at the central bank. Ignoring completely any questions about monetary policy, the question I address here is how a central bank reconciles banks' need for settlement with its own need to maintain a targeted level of base money.

Rules about the account balances banks hold at the central bank are necessary if the central bank is to control the monetary base. Private banks have no earnings incentive to hold any substantial balance in their accounts with the central bank, because such balances typically earn no interest.<sup>1</sup> If a bank foresees ending the day with a positive balance, it can lend that amount overnight in markets for funds with same-day payment. Moreover, banks are no different from their own customers: Absent penalties, they have every incentive to use overdrafts as a dependable source of financing, not only during a day, but overnight. This means that in the absence of overdraft and reserve requirement rules, all banks would have an incentive to create balances at the central bank by overdraft, but no incentive to hold all the balances being created.

■ 1 For a rare instance of interest-bearing reserve assets, see Dotsey (1991).

## Sources of Daylight Credit

Enforcing a rule against overnight overdrafts allows a central bank to limit the supply of base money each day. Scarce base money is available only to those who pass a market test (by selling goods, services, or existing securities or by borrowing). This does not, however, limit the intraday supply of base money created by temporary, “daylight” extensions of credit. Much of the daily activity of banks involves daylight credit, which must be repaid by day’s end to avoid overnight overdrafts.

In modern industrialized economies, depositors draw checks and other payment orders on their bank accounts as the immediate quid pro quo for many market transactions, and banks use base money (or deposits at other banks) to settle interbank clearing imbalances. Even payments with same-day settlement can involve delays that make it possible for banks to “pay out” more money than they have on hand at the moment. They rely on daylight credit provided by those institutions that must wait for settlement before being paid in safe base money.

Clearinghouses are a common source of daylight credit. Routine, standardized transactions within groups of banks, securities dealers, or members of exchanges can be covered by blanket agreements about who can do how much business on credit from the other members of the group prior to settlement, and about how to apportion losses if one of its members is unable to settle.

A central bank provides daylight credit if it makes final payments during the day for customer banks lacking sufficient balances to cover payments as they are made. The amount added to the supply of balances will be drained, all else equal, only when a borrowing bank repays the overdraft.

## Repaying Daylight Credit

Repayment of daylight credit from either source should be routine even if banks hold zero balances at the central bank overnight. If all transactions simply involve payments among banks, zero balances are sufficient: What some banks lose from adverse clearings during a day, other banks gain. The losers should be able to borrow or buy what they need from the gainers to cover their positions, as long as they have access to markets with same-day payment.

Difficulties may arise if there is an aggregate shortage of balances in the banking system as a whole. If banks normally hold no excess balances at the central bank, such a shortage will occur on any day during which banks’ balances at the central bank are drained into currency, government or foreign accounts, or other miscellaneous accounts on the central bank’s balance sheet. With too few balances to go around, one or more banks will be unable to repay daylight credit extended by a clearinghouse or the central bank.

Three mechanisms might allow banks to acquire the funds needed to repay daylight credit, despite uncontrolled factors draining balances. One is a central bank’s “defensive” market operations. These are designed specifically to offset uncontrolled factors draining (or adding) base money. Banks’ balances decline whenever a central bank reduces its assets or increases its other liabilities or capital, all else equal. Defensive operations are simply central bank actions taken to offset an undesired net change in all of the factors affecting the aggregate amount of its constituent banks’ balances. The central bank supplies or drains balances in the aggregate, relying on the market to distribute balances to those banks that need them.

Arbitrage associated with reserve requirements is a second mechanism that allows the banking system itself to absorb uncontrolled deviations of the aggregate supply of balances around a policy-intended level. A binding reserve requirement for an averaging period creates an aggregate average demand for central bank balances on the part of banks. The average quantity demanded, however, can be deferred or brought forward on any day in response to movements in interbank interest rates. This interday arbitrage both absorbs the “noise” from uncontrolled supply factors that are offsetting during a reserve averaging period and dampens associated variations in interest rates.<sup>2</sup>

A third mechanism is direct loans from the central bank, whereby it acts as a pure liquidity-motivated lender of last resort to the banking system. Direct lending is used primarily as an

■ 2 The power of a reserve requirement to produce noise-absorbing arbitrage has limits, however, at least in the short run. On the low side, problems can arise if payments are made by direct transfers of central bank balances, but the central bank limits the availability of daylight overdrafts. Even though banks may be willing to postpone holding overnight balances, there may be too few balances to allow all banks to meet their payment needs during a day within the existing institutional environment. On the high side, some banks might inadvertently accumulate such large reserve positions early in an averaging period that they could avoid excess reserves for the whole period only by running overnight overdrafts, which are prohibited (Dumitru and Stevens [1991]).

escape valve when defensive operations and reserve averaging fail to offset factors draining reserves from the nation's banks, or when unexpected factors increase reserve demand. Banks normally are discouraged from relying on direct central bank loans, with lending rationed by administrative decision (Banks of England and Japan), by banks' reluctance to borrow (Federal Reserve), or by a loan rate that generally exceeds market rates (Bundesbank). For these reasons, individual banks typically do not plan to repay daylight credit by borrowing directly from the central bank. Instead, they try to acquire balances in the market — balances created deliberately by the central bank and coaxed out of the holdings of other banks.

Repayment problems might arise, however, even with no aggregate shortage of balances at the central bank. A bank may be unable to repay daylight credit because either its incipient failure or an operational problem (such as a computer breakdown) prevents borrowing from, or selling assets to, other banks with excess balances at the central bank. Central bank, commercial bank, and clearinghouse rules that prevent unlimited use of daylight credit protect against this problem.

Conceptually, this source of repayment problems can be reserved for a fuller discussion of central banks' lender-of-last-resort and bank supervision functions.<sup>3</sup> As a practical matter, however, a central bank may have difficulty maintaining such a clean distinction between direct lending as a safety valve for aggregate shortages of reserve balances and the importuning of either troubled banks or (in the United

■ **3** The daylight credit involved in making payments causes well-known payments system risk problems for banks, their clearinghouses, and their central banks. In particular, a central bank needs to manage credit risk.

Daylight credit extensions on private net settlement systems can involve systemic risk problems. If payment finality is guaranteed by a clearinghouse (a regulatory requirement advocated by the major central banks), failure of a bank to cover a negative position at settlement requires other participants to make up the difference. Such guarantees are now explicit in the rules of the Clearing House Interbank Payments System (CHIPS) in the United States and the Gaieteme (Foreign Exchange) Yen System in Japan.

An alternative structure makes payment finality contingent on successful completion of the settlement process at the end of a day, as in the Towne Clearing of same-day paper check payments in London. In such instances, a bank's failure to cover a negative position precludes settlement and implies disintegration of the day's payments, leaving their status subject to negotiation or litigation. Another possibility, explicit in the rules of some clearinghouses, is to "unwind" the settlement; that is, to exclude all payments to and from the offending bank and calculate a new settlement. However, at least in the case of large-value, same-day networks, the typical perception is that a central bank would prevent disintegration, or an unwinding, by lending to ensure successful completion of the original settlement (Stevens [1989], Bank for International Settlements [1990b]).

States) banks attempting to take advantage of a below-market discount rate.

## II. Daylight Credit

Private clearinghouses operate in each of the four countries considered here, with same-day net settlement on the books of the central bank. In addition, the Federal Reserve Banks, the Bundesbank, and the Bank of Japan operate their own on-line payment networks that enable banks to make immediate payments throughout a day by transferring central bank balances directly to other banks.<sup>4</sup>

Central bank daylight overdrafts are provided only in the United States and Germany, from payments made on the Fedwire electronic network operated by the regional Federal Reserve Banks, and on the express electronic and paper transfer network operated by the Bundesbank. Both systems include thousands of participants and are dominated by large-value payments. However, the incidence of daylight overdrafts might be expected to be greater on Fedwire, where they average more than \$100 billion daily, than on the Bundesbank system. This is because the value of payments relative to gross domestic product (GDP) made on Fedwire is more than five times greater than on the Bundesbank network, and the ratio of payments to balances is more than 30 times larger (Bank for International Settlements [1990a], Board of Governors [1989]).

The Federal Reserve permits daylight overdrafts for most banks within established limits, but will begin phasing in a fee of 25 basis points (annual rate) in 1994.<sup>5</sup> Compliance with limits is verified on an ex post basis, rather than by preventing excess payments (as is now done, for instance, on the CHIPS large-value transfer system). The Bundesbank, in contrast, apparently does not execute payments that would produce a daylight overdraft exceeding a bank's preexisting collateral, and does not impose a fee.

The Bank of Japan's large-value same-day payments systems (Bank of Japan Cheque and Financial Network Systems) are comparable to those of the Federal Reserve Banks and the Bundesbank. However, the Bank of Japan will not execute payments that would result in a daylight overdraft. To acquire balances in time

■ **4** Descriptions of the four nations' payment mechanisms can be found in Bank for International Settlements (1985, 1990a).

■ **5** A small number of banks with daylight overdrafts in excess of limits and arising from transfers of Treasury securities in the Federal Reserve book-entry system must post collateral.

TABLE 1

**Combined Balance Sheet of  
the Federal Reserve Banks<sup>a</sup>**

Assets		Liabilities	
Gold and Special Drawing Rights	11,068	Components of base money:	
Government securities:		Currency	267,657
Outright	241,431	Banks' balances	38,658
Repurchase agreements	18,354	Government balance	8,960
Loans to banks <sup>b</sup>	190	Other deposits	611
Denominated in foreign currencies	32,633	All other liabilities and capital accounts	11,691
All other assets	23,901		
Total	327,577	Total	327,577

a. As of December 31, 1990. All figures are expressed in millions of dollars.

b. 0.5 percent of balances.

SOURCE: Board of Governors of the Federal Reserve System.

to make payments, banks must manage their balances throughout a day, perhaps by borrowing intraday or overnight, or by selling assets during a day for payment over the network.

Whereas the Bank of Japan prohibits daylight overdrafts, the Bank of England does not provide them because it doesn't operate any payments systems. Interbank payments take place entirely through private clearinghouse arrangements, not on the books of the central bank. Each day, only the net settlement position of a bank vis-à-vis all other banks in one or more clearinghouses is settled using the bank's account at the central bank. Even if a bank could settle its clearinghouse position only with an overnight overdraft or loan from the Bank of England, the Bank has no formal responsibility to guarantee settlement.

In the past, Federal Reserve provision of daylight overdrafts clearly was more liberal than at the other three central banks. Until 1986, no limits were imposed and no collateral was required for healthy depository institutions. Provision began to move toward comparability in 1986, with the adoption of the potentially more restrictive current limits, based on a bank's capital. With the imposition of a fee in 1994, Federal Reserve provision will become somewhat more like that of the other central banks.

### III. Defensive Operations

The level of short-term interest rates is the effective policy instrument of each of the four central banks considered here. Defensive operations are deliberate actions taken to insulate the supply

of base money, and thereby the level of directly affected short-term interest rates, from uncontrolled changes that are inconsistent with policy intentions. Most defensive operations take place within the daily market period in which shortest-term interest rates reflect the forces of demand and supply in the market for banks' balances — what Niehans calls “the ultrashort-run liquidity of the banking system.” (Niehans [1978], chapter 12) The length of the ultrashort run — from a few minutes to as much as a week — may be related to reserve requirement arrangements, which are discussed in section IV.

All four central banks use one or both of two basic techniques in their defensive operations: 1) *managing* flows of banks' balances to and from government and official foreign accounts at the central bank, and 2) using market transactions and lending to *offset* unmanaged factors affecting the central bank balance sheet or interest rates. In what follows, I discuss the use of these techniques by each of the four banks.

### Federal Reserve

The Fed uses both techniques. Monetizing government securities through outright purchases in the secondary market or directly from foreign customers is the dominant source of base money in the United States (see table 1). Fluctuations in the Treasury's balance at the Reserve Banks, if not offset, change the supply of banks' balances at the Fed. This is avoided, for the most part, by having the Treasury maintain two sets of deposit accounts: one with banks, to which its receipts are paid, and another at the Federal Reserve

TABLE 2

**Balance Sheet of the Deutsche Bundesbank<sup>a</sup>**

Assets		Liabilities	
Gold, Special Drawing Rights, and net claims on the European Monetary Cooperation Fund	39,219	Components of base money:	
Securities:		Currency	150,548
Outright		Banks' balances	66,874
Bills of exchange <sup>b</sup>	61,309	Government balance	5,149
Other	4,262	Other deposits	54,916
Repurchase agreements	108,828	All other liabilities and capital accounts	<u>31,083</u>
Lombard loans	5,187		
Denominated in foreign currencies	58,308		
All other assets	<u>31,456</u>		
Total	308,570	Total	308,570

a. As of December 31, 1989. All figures are expressed in millions of marks.

b. 92 percent of balances.

SOURCE: Deutsche Bundesbank.

Banks, from which its payments are made. The Treasury can transfer funds from the receiving accounts to the paying accounts each morning to offset the day's projected payments. This practice leaves a relatively constant projected target balance in the paying accounts, preventing Treasury operations from adding or draining banks' balances.<sup>6</sup>

Defensive operations are used to offset short-run variations in the public's demand for currency and in banks' demand for required balances, as well as in a host of miscellaneous items. The vehicle for temporary defensive operations is repurchase agreements (RPs) in the secondary market for Treasury securities — that is, purchases (to add balances) with an agreement to resell, or sales (to drain balances) with an agreement to buy back, one or a few days later. Transactions are conducted by inviting bids from designated (primary) dealers and by accepting enough bids to fill the projected need on a best-bid basis. These frequent, temporary adjustments can be used to fine-tune the supply of balances on a daily basis. When needed, transactions take place at about 11:30 a.m., based on projections of demand and of

factors affecting supply. The banking system must accommodate any deviation of actual from projected balances for the day, although as noted above, a substantial shortfall could force banks to borrow at the discount window.

Defensive operations are not always based on projected quantities. The Fed's proximate monetary policy target is perceived as a level of the overnight interbank (federal funds) rate. Deviations of the funds rate from target can indicate projection errors or market expectations that are inconsistent with policy. Operations in the secondary market, therefore, may be intended to defend or to correct the market's perception of the interest-rate policy target (Meulendyke [1989]).

### Bundesbank

In contrast to the Federal Reserve, the Bundesbank does not rely on outright purchases of government securities as its dominant means of supplying base money (see table 2). A large portion of base money is supplied (within established "refinancing" quotas) through purchases of domestic and foreign bills of exchange with maturities of several months. Banks sell these instruments to the central bank at the official discount rate, which is typically below market rates. An even larger source of base money originates from the continuous rollover of RPs of one- and two-month maturities.

■ <sup>6</sup> Banks' balances at the Federal Reserve Banks could be completely insulated from the effects of Treasury operations (within projection errors), were it not for occasional episodes when 1) paying accounts must move above the normal target because receipts exceed banks' limited willingness to hold Treasury deposits, or 2) receiving accounts are exhausted and the paying accounts must be drawn down below the normal target because the Treasury is constrained from issuing new debt.

TABLE 3

**Balance Sheet of the  
Bank of Japan<sup>a</sup>**

Assets		Liabilities	
Gold	140	Components of base money:	
Securities:		Currency	39,798
Government bonds	31,542	Banks' balances	4,881
Bills and commercial paper	6,906	Government balance	521
Bills discounted	144	Other deposits	424
Loans <sup>b</sup>	6,160	All other liabilities and capital accounts	<u>3,533</u>
Denominated in foreign currencies	2,996		
All other assets	<u>1,269</u>		
Total	49,157	Total	49,157

a. As of December 31, 1990. All figures are expressed in billions of yen.

b. 126 percent of balances.

SOURCE: Bank of Japan.

The Bundesbank adjusts the aggregate supply of banks' balances weekly, typically by regulating the volume of RPs accepted. Other means of adjustment include shifting federal government deposits to banks, foreign exchange swaps or RPs, and sales of special short-maturity Treasury bills. But, for the most part, any remaining need for short-run adjustments must come at the initiative of the banks themselves, by varying their Lombard borrowing from the Bundesbank (collateralized by eligible securities) at the Bank's Lombard rate. This rate always is higher than the discount rate and typically is higher than market rates (Deutsche Bundesbank [1985, 1990]).

The Bundesbank also has an opportunity to indicate when the overnight interbank rate has been affected by either projection errors (undersupply, for example, would be expected to drive the rate up toward the Lombard rate) or a market perception of rates inconsistent with actual policy intentions. Both the cutoff rate in accepting RPs and the volume accepted can provide short-run signals to the market. A more direct signal can be given by inviting tenders for RPs at a designated interest rate, rather than by simply accepting the best rates offered for a desired quantity.

### Bank of Japan

Like the Federal Reserve, the Bank of Japan holds a large portfolio of government securities whose outright purchase is the dominant source of base money (see table 3). The Bank also can

operate in a variety of other markets to adjust the monetary base and to influence conditions in specific markets. These actions include engaging in Treasury bill and commercial paper RPs, purchases and sales of commercial bills (including sales of Bank of Japan bills), and sales of government bills with an RP. In addition, a pivotal group of large banks is continuously indebted to the central bank, within established lines of credit, at the basic discount rate, which is typically below interbank lending rates (Tatewaki [1991]).

The Bank of Japan has two daily opportunities to adjust the supply of balances. One is through operations in the market (typified by commercial paper RPs) aimed at the market rate on uncollateralized interbank call loans — the counterpart to the federal funds rate in the United States. The second is by a later daily decision about the quantity of loans the Bank will extend or collect. This lending decision is made shortly before 3:00 p.m., when same-day transactions in the call loan market must end (because the Bank's same-day payments network closes), but about an hour after same-day net positions on the Gaiteme foreign-exchange net settlement network have been calculated. Thus, Bank of Japan lending decisions can accommodate a need for balances, or put upward or downward pressure on the call loan market, based on information accumulated during the day. The Bank assists the market in distinguishing defensive operations from those with policy implications by releasing data, also at 3:00 p.m., showing demand and supply of funds and its

TABLE 4

**Balance Sheet of the Bank of England<sup>a</sup>**

Assets		Liabilities	
<b>Issue Department</b>			
Securities:		Currency	15,021
Government	10,021	Other	9
Other	5,009		
Total	15,030	Total	15,030
<b>Banking Department</b>			
Securities:		Banks' operating balances	175
Government	843	Government balance	454
Bills discounted	1,540	Other deposits:	
Loans	651	Cash ratio	1,491
All other assets	1,302	Other	1,288
		All other liabilities and capital accounts	928
Total	4,336	Total	4,336

a. As of February 28, 1990. All figures are expressed in millions of pounds.  
SOURCE: Bank of England.

own market operations for that day, as well as an estimate for the next day (Nakao and Horii [1991], Bank for International Settlements [1986, 1990a], and Bank of Japan [1991]).

**Bank of England**

The Bank of England maintains an accounting distinction between two departments. The Issue Department supplies currency, which finances outright holdings of government and other securities. The Banking Department supplies the small amount of banks' deposit balances (there are no reserve requirements), largely by discounting (purchasing) eligible securities and through collateralized lending (see table 4). Weekly government bill tenders normally drain enough funds from the banking system to the government's account to create a persistent shortage of balances, requiring daily defensive operations to add balances back into the system.

Procedures for defensive operations are elaborate, because banks' small cushion of desired "target" balances provides little room for error in draining or adding balances each day. Banks report their targets to the Bank of England, and at three times during the day, the Bank reports its estimate of the day's shortage or surplus of balances relative to the aggregate of these targets. Open-market operations typi-

cally are carried out with the discount houses, which in turn provide banks with daily financing facilities.

Operations might be conducted after publication of the first estimate of the day's balance position, if the need is large. More often, the Bank operates after releasing its noon update of estimated need. A third round of operations may come after the Bank's 2:00 p.m. update. A further opportunity to adjust comes through "late assistance" in the form of secured lending to discount houses and other money brokers, which may extend later into the afternoon.

Operations at any of these times can do more than simply adjust the quantity of balances. The Bank has discretion over the type of operation (outright, RP, lending), whether it invites transactions or responds to requests, and the terms on which it will engage in transactions (type of security, maturity, and "stop rate"). Manipulation of these variables, in conjunction with the Bank's published estimates of the day's position, provides an opportunity for the Bank to clarify its policy intentions while engaging in defensive operations (Bank for International Settlements [1986, 1990a], Bank of England [1988]).



## Summary

All four central banks engage in defensive operations along the twin dimensions of quantity of balances and level of interest rates. Where control of the quantity of balances is not effective or, for some other reason, market expectations are not consistent with policy intentions, the central banks can manipulate the types and terms of their market operations to provide signals — interpreted on the basis of market traditions — about the level of interest rates thought to be consistent with policy intentions. No amount of such suasion can be effective, however, if not supported by control of the quantity of balances.

Clear differences are visible in the degree to which any of the four central banks might be expected to seek precise control of the daily aggregate supply of balances and relevant interest rates using defensive operations. The Bundesbank's reliance on weekly RPs leaves the daily supply of balances subject to uncontrolled factors that might move interest rates within the ceiling provided by the Lombard rate. Federal Reserve reliance on morning open-market operations, guided only by projections, means that the actual daily supply of balances is subject to projection errors, although daily signals may be sufficient to maintain clarity about the level of interest rates consistent with policy intentions.<sup>7</sup> The Bank of Japan, by making decisions about lending and repayment late in the day — after one clearinghouse has closed and immediately before the close of another — is in a better position to avoid projection errors in its daily defensive operations. The Bank of England, relying on successive estimates, operations, and late assistance over the course of a single day, can minimize projection errors by using repeated updates of market information to estimate the need to adjust the aggregate supply of balances.

## IV. Reserve Requirements

A banking system is in a better position to absorb day-to-day uncontrolled variations in the supply of balances when banks must meet reserve requirements. The central bank must eliminate any net excess or deficiency of balances by the end of the reserve averaging period, but not every day.

A bank calculates its required reserves by matching various reservable deposits with their respective reserve ratios. Specifications of both reservable deposits and reserve ratios differ in widely inventive ways among the four central banks. These computational features influence the net after-reserves marginal cost of bank lending financed by various types of deposits. They also might be germane to monetary policy operations. For example, predictability of demand for reservable balances and the accuracy of projections underlying defensive operations are affected by shifts among deposit accounts having different reserve ratios.<sup>8</sup> However, these features will not be considered here because they are not of foremost importance to the interaction of central banks' reserve requirement rules with their monetary and payments system operations in the "ultrashort run." Rather, of interest here are 1) the average quantity of non-interest-bearing reserve balances that banks must hold and 2) the length of the averaging period over which banks can spread this artificial demand and over which the central bank can spread its supply.

Three of the four central banks had reserve requirement regulations in 1990. The aggregate quantity of required balances in each country can be compared directly only by choosing exchange rates at which to convert to a common currency. Examining the ratio of required balances to a country's GDP avoids this complication, while making a rough adjustment for differences in the scale of national economies.<sup>9</sup> Both methods of comparison are shown in table 5, with required and excess balances converted to U.S. dollars, as well as scaled by each country's nominal GDP.

■ 7 "Large" projection errors occurred on 27 days in 1991, according to the Federal Reserve Bank of New York, but "large" is undefined. The New York Bank conducts a weekly Thursday press briefing that reviews in general terms the factors affecting banks' reserve balances during the week ending the previous day. Among other items, the briefing indicates either 1) that there were no large net one-day deviations from projections, or 2) the days on which there were large deviations, giving their sign and source but not their dollar values.

■ 8 A convenient comparison of the basis for computing required reserves in the four countries can be found in Kneeshaw and Van den Bergh (1989). The irrelevance of methods of computation for monetary policy implementation is discussed in Stevens (1991).

■ 9 An alternative scale adjustment is to take the ratio of required balances to total deposits (whether subject to requirements or not) of all institutions that are subject to requirements. The rank order is the same as for GDP.

TABLE 5

**Banks' Deposit Balances  
at Central Banks<sup>a</sup>**

	Required		Excess		Days in Averaging Period	Penalty for Deficiency
	Millions of U.S. dollars	Percentage of GDP	Millions of U.S. dollars	Percentage of GDP		
Federal Reserve <sup>b</sup>	33,843 <sup>c</sup>	0.61 <sup>c</sup>	933	0.017	14 <sup>d</sup>	Discount rate +2%
Bundesbank <sup>e</sup>	29,782	2.52	189	0.016	30	Lombard rate +3%
Bank of Japan <sup>f</sup>	33,410	1.14	28	0.001	30	Discount rate +3.75%
Bank of England <sup>g</sup>	n.a.	n.a.	232	0.024	1	n.a.

a. 1990 annual averages. Currency conversions are at the annual average exchange rate.

b. Reserve requirements were cut substantially in December 1990 and April 1992. The average dollar amount of required plus clearing balances declined 25 percent between May 1990 and May 1992.

c. Includes (after rounding) 0.59 percent of required balances and 0.03 percent of clearing balances.

d. Ninety-one days for small banks.

e. 1989 values are used to avoid discontinuity caused by reunification.

f. Holdings of vault cash cannot be deducted from required reserves in calculating required balances.

g. Excludes "cash ratio" deposits.

SOURCES: Bank of England, Board of Governors of the Federal Reserve System, Deutsche Bundesbank, Bank of Japan, and the International Monetary Fund.

### Federal Reserve

In the United States, large banks must meet reserve requirements within a basic 14-day averaging period. Each bank can rely on daily market transactions to manage balances, aided by a provision for carryover of excesses or deficiencies into the next 14-day period that creates a limited 28-day averaging period.<sup>10</sup> A bank's holdings of vault cash, as well as its deposit balance at a regional Reserve Bank, are eligible to satisfy the legal reserve requirement. Even some of the largest institutions satisfy their entire requirement with vault cash.

In addition to a legal reserve requirement, many banks contract to hold required clearing balances during a reserve maintenance period. These required balances are administered on the same basis as the legal requirement, but yield earnings credits at the level of the federal funds rate with which to pay for Reserve Banks'

priced services. Failure to maintain at least the required amount of vault cash plus legal and clearing balances, after carryover, results in a fee levied on the deficiency at a rate of 2 percentage points above the discount rate. This charge, in addition to administrative opprobrium, makes deficiencies rare.

### Bundesbank

Required balances in Germany are of an order of magnitude roughly comparable in dollar value to the aggregate quantity held by U.S. and Japanese banks, but are substantially higher relative to GDP. In addition, a long, 30-day averaging period provides the German banking system with a substantial ability to absorb offsetting variations in the daily supply of balances. All institutions subject to reserve requirements must maintain a required deposit balance. Vault cash is eligible to meet requirements, but only up to 50 percent of the amount of a bank's required reserve. Failure to satisfy the reserve requirement results in a penalty at a rate 3 percentage points above the Lombard rate (which itself is typically higher than market rates).

■ 10 The Federal Reserve appears to be unique in allowing this additional averaging between adjacent periods (see Kneeshaw and Van den Bergh [1989]). A deficiency or excess of up to 4 percent of required reserves (increased from 2 percent in 1992) can be carried into the next averaging period (but not beyond). Because many banks satisfy a large portion of their reserve requirement with vault cash, eligible carryover can be much larger than 4 percent of required balances.

## Bank of Japan

Required reserves in Japan, while of the same order of dollar magnitude as those in Germany and the United States, stand in an intermediate position when measured relative to GDP—almost twice the U.S. ratio, but only half the German ratio. Like German banks, Japanese banks maintain required reserves within a 30-day averaging period, providing the banking system with a significant ability to absorb offsetting daily variations in the supply of balances. All required reserves must be held as balances with the Bank of Japan: Vault cash holdings do not satisfy reserve requirements. The penalty for a reserve deficiency is a rate 3.75 percentage points above the official discount rate.

## Bank of England

The United Kingdom is unique among the four countries in having no reserve requirement regulation.<sup>11</sup> Banks do target, and hold, self-determined levels of operating balances as a buffer against lower-than-expected clearing-house net positions at the end of a day. In the aggregate, however, this practice has almost none of the shock-absorbing function associated with a reserve requirement: It is impossible for banks to accommodate daily variations in the aggregate supply of balances by postponing or accelerating the accumulation of balances. Extra balances today are worthless on future days, while an unexpected shortage today can be no greater than target balances. And target balances are quite small—about one one-hundredth of required balances in Germany, and normally smaller than the size of daily defensive operations conducted by the Bank of England.

## National Differences in Required Balances

There is no obvious rationale for the observed national differences in the level of balances a banking system is required to maintain on

deposit at its central bank. One striking association can be detected: Less frequent defensive operations tend to be related to higher requirements that allow the banking system itself to absorb daily, offsetting variations in the supply of balances. The Bundesbank, with the highest level of required balances, tends to rely on weekly operations; the Federal Reserve, with an intermediate level of required balances, tends to rely on daily operations; the Bank of England, with no required balances, may take action as frequently as four times a day.

Association is not explanation, however. Are reserve requirements lower because a central bank is more assiduous in controlling the supply of balances, or does a central bank control the supply of balances more assiduously because reserve requirements are lower? Moreover, the association is not consistent across the four central banks: The relatively high level of requirements in Japan would seem to allow the Bank of Japan to be less attentive than it is in conducting defensive operations.

Other factors that might account for differences do not explain much, either. Longer averaging periods could be a substitute for higher requirements, but that is not the pattern actually observed (see table 5).<sup>12</sup> Provision of daylight overdrafts could likewise substitute for higher balances, but no such pattern is evident. For example, while the Bank of Japan prohibits daylight overdrafts, the level of required balances relative to GDP is only half that of the Bundesbank, which does allow such transactions.

Perhaps another factor is at work. A central bank might offset the “tax” of a relatively high reserve requirement with the “subsidy” of loans to banks at below-market rates. A perfect offset would leave the marginal cost of lending unaffected by reserve requirements, but none of the four central banks operates this way. More likely is a partial offset to the total cost of operating within all the rules of the central bank. The national basis for this offset is indicated in the footnotes to tables 1–3, as measured by total central bank assets acquired from the banking system at subsidy rates, divided by banks’ required balances held with the central bank.

The ratio of subsidized assets to required balances varies from about zero at the Federal Reserve Banks to a high of 126 percent at the Bank of Japan. These values provide some evidence that the cost of required balances may

■ 11 Institutions with more than minimum amounts of eligible liabilities must hold nonoperational, non-interest-bearing “cash ratio” deposits, fixed for six-month intervals at about one-half of 1 percent of both demand and term deposits (without averaging) to finance the Banking Department of the Bank of England. This arrangement is more nearly analogous to the Fed’s requirement that member banks hold stock in a Federal Reserve Bank than to a reserve requirement.

■ 12 Extra days could replace extra balances in deferring and accelerating the accumulation of required balances while accommodating a given pattern of variations in supply; supply variations might be more likely to be offsetting over longer averaging periods.

not be as unequal as their levels, but that the offset from the subsidy cannot equalize cost. For example, a simple calculation suggests that the Bundesbank would have to maintain a negative discount rate in refinancing bills of exchange if it were to offset the difference between the GDP-based measure of its required balances and that of the Federal Reserve.<sup>13</sup> Moreover, even a plausible association between required balances and subsidized assets would not explain why nations might choose these different institutional patterns.

Just as it is impossible to explain why reserve requirements differ, so, too, it is hard to explain variations in the average level of excess balances among the four banking systems (see table 5). One interpretation of excess balances might be that they measure the accuracy of a central bank's defensive operations. If banks have no incentive to hold non-interest-bearing idle balances, defensive operations must aim at zero excess balances to prevent extreme volatility in interbank interest rates.

Information about excess balances alone is not sufficient to justify this interpretation, however. Even if a central bank were able to achieve zero excess balances, normal practice would be to target a positive level, demanded by banks in the aggregate. Individual banks have an incentive to target small excess balances on the last day of a reserve averaging period. This reflects the monetary and nonmonetary penalties for failing to meet requirements, coupled with each bank's inevitable uncertainty about both the incidence of unplanned, last-minute transactions and the accuracy of its record keeping. Observed excess balances may reflect actual demand, not inaccurate supply.

A bank operating in the context of a positive requirement normally will have a cushion of balances so that it can operate closer to a zero target for excess balances than a bank with no balance requirement. With a requirement, the cushion is lacking only on the last day of a reserve maintenance period, when the bank can no longer postpone or accelerate the accumulation of required balances; without a requirement, the cushion is lacking every day. This may explain why excess balances are highest at the Bank of England — assuming, of

course, that actual balances are an indication of banks' desired balances rather than of errors in defensive operations.

Lower excess balances at the Bundesbank may reflect another difference: German banks may be willing to set targets closer to zero excess balances because they can rely on Lombard borrowing to round out their reserve position at the last moment on the last day of an averaging period, albeit at an above-market price (and not repeatedly). The Bank of England and the Federal Reserve Banks do not maintain lending facilities as hospitable to last-minute borrowing by individual banks. Bank of Japan lending might account for the minuscule level of excess balances in that country, either as a means of achieving precision in supplying balances or, given such precision, as a reflection of low demand on the part of individual banks in anticipation of precise supply.

## V. Conclusion

The central banks of the United States, Germany, Japan, and the United Kingdom perform the same basic functions. In the payments system, they provide safe, base money both as currency and as banks' deposit balances, as well as a facility for settling clearinghouse payments through bookkeeping transfers of banks' balances. In addition, the Federal Reserve, Bundesbank, and Bank of Japan all provide a system for making same-day payments by direct transfers of banks' balances. Each attempts to provide the quantity of base money required to maintain short-term interest rates at policy-desired levels.

To facilitate payments, some central banks (the Banks of Japan and England) rely entirely on clearinghouse organizations to supplement the supply of base money with daylight credit. Others (the Federal Reserve and Bundesbank) supplement the supply of base money themselves during the day by providing daylight overdrafts.

All four central banks engage in defensive operations designed to insulate the overnight supply of banks' balances and the level of short-term interest rates from the temporary effects of variations in currency holdings, government balances, and other uncontrolled factors. The four differ, however, in the extent to which reserve requirements enable the banking system itself to accommodate day-to-day shocks to the supply of banks' balances arising from these factors. The contrast is most apparent between the Bank of England, with no reserve requirements and multiple defensive operations each

■ 13 Let  $R$  equal the market rate forgone on reserve balances, and  $s$  equal the subsidy to that rate for central bank loans. In the case of the Bundesbank, for example, from the values in tables 2 and 5,

$$0.92s = 2.52R - 0.61R.$$

That is,  $s = 1.92R$ . The level of the subsidy would be almost twice the level of the market rate, implying a negative loan rate at the central bank.

TABLE 6

**Summary Comparison of Central Bank Rules and Operations, 1990**

	Federal Reserve	Bundesbank	Bank of Japan	Bank of England
<b>Sources of Daylight Credit</b>				
Private clearinghouses	Yes	Yes	Yes	Yes
Central bank	Yes, within line of credit, monitored ex post (fee begins in 1994)	Yes, within limit of Lombard collateral; no fee	No	No
<b>Sources of Overnight Balances</b>				
Overnight overdraft	Penalty	Lombard loan	Prevented	Discretionary
Central bank defensive operations	Daily if needed; in morning, from projections of demand and supply	Weekly or more frequently	Twice daily if needed, before and after close of clearinghouse	Four times daily if needed, before and after close of clearinghouse
<b>Reserve Requirement</b>				
Level	High, but falling	Highest	Higher	None
Averaging period	14-day, with limited 28-day	30-day	30-day	None

SOURCES: See references in text.

day, and the Bundesbank, with high reserve requirements and major reliance on weekly defensive operations.

The fundamental lesson of this study is that there is no unique set of rules a central bank must impose on the banking system (see table 6). Monetary and payments system functions can be carried out under a variety of rules and regulations whose relative costs would be enormously difficult to establish.

Applying this lesson to the Federal Reserve helps to clarify some recent issues. A common apprehension about limiting banks' daylight overdrafts has been the possibility of payments system "gridlock," which some fear would require banks either to hold costly excess balances at the Federal Reserve Banks or to develop a finely tuned system for trading and transferring balances on an hourly or partial-day basis. Experience in nations whose central banks do not provide daylight credit suggests another likely alternative: Banks will rely more extensively on private clearinghouses in making payments.

Lowering, or even eliminating, reserve requirements has considerable appeal in the United States, where their apparent burden on banks' domestic and global competitiveness

seems unrelated to their statutory monetary policy rationale. Deregulating the banking system by removing reserve requirements, however, would have the seemingly paradoxical effect of increasing, rather than decreasing, the pivotal role of the central bank in the money market. As in the case of the Bank of England, assiduous defensive market intervention could be necessary each day simply to match the daily supply of banks' balances with any residual precautionary demand. Alternatively, copying the Bundesbank's Lombard facility, the Federal Reserve Banks' discount window lending could play a larger defensive role if administrative and market discouragement of borrowing were abandoned in favor of a penalty discount rate.

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