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Chapter 13
BEHIND THE MONEY MARKET: CLEARING AND SETTLING MONEY MARKET INSTRUMENTS

David L. Mengle

Whenever a money market instrument is traded, some means must exist for transferring the instrument and for making payment. In other words, there is a necessity for clearing and settling the trade, tasks that are usually referred to as operational, or back-office, functions.

Clearing refers to processing a trade and establishing what the parties to the trade owe each other. Settlement refers to the transfer of value between the parties so the trade is completed (Group of Thirty 1989, p. 35). The first step in the clearing and settlement process involves conveying the details of the trade from traders to the back office. Second, the details must be compared and matched between the buyer and seller to ensure that both buyer and seller agree on what is to be traded and on what terms. Failure to do so might lead to delivery problems. This chapter will focus on what happens next: determination of the obligations between the parties and settlement of the trade.

Clearing and settlement systems link the participants in the money market. This chapter uses examples to describe how clearing and settlement take place for various types of money market instruments.[1] In addition, it discusses risks inherent in clearing and settlement, and the steps being considered to reduce such risks.

WHERE BANKS FIT IN

Banks and the interbank payment system are at the center of the clearing and settlement mechanism for the money market. Banks connect the participants in the money market by acting in three capacities. First, they act as agents for issuers of money market instruments, which means they perform the physical tasks of issuing and redeeming instruments in the market and of maintaining registration records. Second, they act as custodians of instruments, which involves

[1] For a more detailed description of the operational side of the money market, the reader should consult Marcia Stigum's treatment in *After the Trade*.

safekeeping them as a service to investors. Like valuables kept in a safe-deposit box, instruments entrusted to a custodian bank do not show up on the bank's balance sheet as either assets or liabilities because they remain the property of their owners.

Finally, and most importantly, some banks specialize in clearing. A clearing bank is responsible for transferring securities from one party to another and for transferring payment for the securities. Dealers maintain two types of accounts at clearing banks: securities accounts and funds accounts. When a clearing bank is instructed to transfer securities from Dealer A's securities account to that of Dealer B, the bank also transfers payment for the securities from Dealer B's funds account to that of Dealer A. If the dealers do not use the same clearing bank, then the transaction involves a transfer of securities and funds between two banks.

Transfers between banks take place at the hub of the money market, the interbank payment system. Even when instruments are cleared outside the banking system, as is the case when a dealer firm clears for itself, payment takes place through banks. The payment system, which links banks to each other, includes both paper checks and electronic funds transfer, although almost all interbank payments now occur electronically over wholesale wire transfer networks.[2]

The main wholesale wire transfer network in the United States is Fedwire, which operates through bank reserve accounts at the 12 Federal Reserve Banks. Fedwire can be used to transfer both funds and book-entry U.S. government securities (to be described presently) between banks and other depository institutions. During 1991, about 260,000 Fedwire funds transfers totaling about $766 billion occurred on an average day. Mean transfer size was about $3 million. In addition, over 44,000 book-entry securities transfers amounting to about $476 billion occurred daily. The average book-entry transfer was about $10.8 million.

Table 1 shows how Fedwire is used to complete a federal funds transaction. Assume that Bank of Downtown finds itself with $10 million of excess reserves while Midtown Trust is $10 million short of required reserves. A broker matches the two and arranges for Downtown to sell (lend) $10 million to Midtown, so Downtown's excess reserves will be used to fund Midtown's shortage. Settlement of the transaction will occur through reserve accounts at their Federal Reserve Bank.[3] When Downtown initiates the transfer, its reserve account at the Fed is reduced by $10 million. Within a split second, Midtown's reserve account is increased by the same amount. Once made, the Fedwire payment is final and irrevocable. Notice that on the books of the Fed the transfer simply moves reserves from the account of one bank to that of the other. The next day, Midtown uses Fedwire to repay the funds and essentially reverses the process.

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[2] Wholesale wire transfer networks link banks with each other. In contrast, retail wire transfer systems, such as automated teller machine networks, link banks with consumers.

[3] If the two banks are in separate Federal Reserve districts, the transaction will involve accounts at two different Federal Reserve Banks.

TABLE 1

Fedwire Message Between Banks

(in millions of dollars)

Bank of Downtown		Federal Reserve Bank		Midtown Trust	
Assets	**Liabilities**	**Assets**	**Liabilities**	**Assets**	**Liabilities**
Reserves -10			Reserves, Downtown -10 Reserves, Midtown +10	Reserves +10	

An important feature of Fedwire transfers is that they are settled on a bilateral, trade-for-trade basis, also known as gross settlement. If, instead, transfers were consolidated into net positions between banks or between banks and the network in order to reduce the actual number of interbank transfers that take place, the system would be called a netting system (see box, "Netting and Net Settlement"). Netting can take two forms. Bilateral netting combines gross obligations between banks into net obligations so each pair of banks in a system exchanges only one settlement payment. Multilateral netting combines each bank's bilateral net positions into "net net" obligations between the bank and the other banks in the system. When settlement occurs, each bank is either a net creditor (one that is owed money by the rest of the system) or a net debtor (one that owes money).

The Clearing House Interbank Payments System (CHIPS) is a multilateral netting system. It is owned and operated by the New York Clearing House, a private organization. CHIPS transfers only funds and not securities, and is used largely, although by no means exclusively, in connection with international transactions such as Eurodollars and foreign exchange (Clair 1991). During 1991 approximately 150,000 transfers totaling about $866 billion took place on an average day on CHIPS. Average transfer size was $6 million. At the end of 1991, 126 depository institutions, many of them branches of foreign banks, participated in CHIPS.

CHIPS is organized in a hierarchical fashion whereby a subset of participating banks (20 out of 126) settle directly with CHIPS while the others must settle on the books of one of the settling banks. Settlement occurs at the end of the day, when settling banks in net debit positions send (over Fedwire) the funds they owe to a special CHIPS net settlement account at the Federal Reserve Bank of New York. CHIPS then wires funds from the account to settling banks in net

NETTING AND NET SETTLEMENT

In order to understand how netting and net settlement work, consider the example of the four banks in Table 2, each of which sends a payment message to each of the other three banks. Bank of Downtown sends transfer messages for $10 million to Midtown Trust, $10 million to Crosstown National Bank, and $10 million to Outatown Bank; Midtown sends $10 million to Downtown, $10 million to Crosstown, and $40 million to Outatown; and so on for a total of 12 separate payments. On a gross settlement system like Fedwire, each of the 12 payment transactions would be settled separately.

If, instead, each bank's obligations to each of the other banks were combined, that is, netted bilaterally, then the result would be the net positions in the first four columns of Table 3. In such a netting system, each bank (read from the left of the matrix) would be in a net credit or net debit position versus each of the other banks (read from the top of the matrix), and settlement would take place when the banks send net payments to or receive net payments from each of the other banks at the end of the day. Since Downtown sent a payment message for $10 million to Crosstown but received one from Crosstown for $40 million, Downtown will have a net credit of $30 million versus Crosstown (which, correspondingly, has a net debit of $30 million against Downtown). Midtown will send $20 million to Outatown; Crosstown will send $30 million to Downtown, $20 million to Midtown, and $10 million to Outatown; and Outatown will send $10 million to Downtown. Since Downtown's and Midtown's payments to each other cancel out, neither will have to send a payment to the other.

Multilateral netting takes the netting process one step further by combining the bilateral net positions for each bank into a net position versus the network. The network adds up the amounts each owes to and is owed by the other banks (obtained by summing the net positions in a bank's row of the matrix). This results in the net net positions shown in the last column of the matrix: Downtown has a net credit of $40 million coming in, Crosstown has a net debit of $60 million going out, Outatown has a net credit of $20 million, and Midtown's incoming funds are offset by its outgoing funds. Settlement occurs when Crosstown sends the network $60 million and the network wires $40 million to Downtown and $20 million to Outatown.

Moving to bilateral netting and then to multilateral netting can mean substantial reductions in the number of actual exchanges between participants. In Table 2 the gross number of transactions is 12 but the number could be far more. By moving to bilateral netting, the number of exchanges of funds is reduced to a maximum of six or, more generally,

$$n(n - 1) / 2,$$

where n is the number of participating institutions. By moving to multilateral netting, the maximum number of exchanges is reduced to n, which in the example is four. Such reductions in the number of exchanges can mean reductions in operational costs and risk exposures between institutions. For specific examples of how risks can both arise in and be avoided by netting, see Gilbert (1992).

TABLE 2
Payment Messages
(in millions)

Sender	Receiver	Amount
Downtown	Midtown	$10
Downtown	Crosstown	$10
Downtown	Outatown	$10
Midtown	Downtown	$10
Midtown	Crosstown	$10
Midtown	Outatown	$40
Crosstown	Downtown	$40
Crosstown	Midtown	$30
Crosstown	Outatown	$20
Outatown	Downtown	$20
Outatown	Midtown	$20
Outatown	Crosstown	$10

TABLE 3
Net Bilateral and Net Multilateral Settlement Obligations
(in millions)

	Downtown	Midtown	Crosstown	Outatown	Net Net
Downtown		$0	$30	$10	$40
Midtown	$0		$20	($20)	$0
Crosstown	($30)	($20)		($10)	($60)
Outatown	($10)	$20	$10		$20

Note: Numbers in parentheses denote a net debit; those not in parentheses, a net credit.

credit positions. The special account starts out with a zero balance and, when settlement is complete, ends with a zero balance; the CHIPS account is used for nothing else.

The results of a 1987 survey of New York banks highlight the international character of CHIPS payments relative to Fedwire payments (Federal Reserve Bank of New York 1987-88). According to the survey, 55 percent of the dollar amount of CHIPS payments was related to foreign exchange transactions; on Fedwire, foreign exchange transactions were negligible. Further, 28 percent of CHIPS dollar value was related to Eurodollar placements; on Fedwire, such transactions were 10 percent of dollar value. Finally, 34 percent of Fedwire dollar value was for federal funds transactions; on CHIPS, the percentage was almost zero.

One last network deserves mention because of its role in international payments. The Society for Worldwide Interbank Financial Telecommunication (SWIFT) is a nonprofit cooperative chartered under Belgian law and owned by 1,885 participating institutions in 73 countries, including the United States. Unlike Fedwire or CHIPS, SWIFT is not a funds transfer system. Instead, SWIFT payment messages instruct banks to transfer funds by means of accounts at correspondent banks.[4] Such a transfer might involve transfers among accounts at the same bank. For example, suppose Bank of Downtown serves as correspondent bank for both Midtown Trust and London Bank and that London Bank wishes to make a payment to Midtown Trust. London makes the payment by sending a SWIFT message instructing Downtown to reduce London's correspondent account and to increase Midtown's by the amount of the payment. Alternatively, a SWIFT message might direct that a payment be made between banks. If London wishes to make a payment to Crosstown National, for example, but Crosstown does not have a correspondent relationship with Downtown, then London's SWIFT message would instruct Downtown to transfer funds (from London's correspondent account) to Crosstown by means of an interbank network like Fedwire or CHIPS.

FORMS OF MONEY MARKET INSTRUMENTS

The form in which a money market instrument is issued and traded largely determines the manner in which it is cleared and settled. Because federal funds are essentially exchanges of bank reserves between accounts at Federal Reserve Banks, they are settled by means of Fedwire transfers. For other money market instruments, how they are cleared and settled depends on whether they are traded in physical (also called "definitive") form or book-entry form. Trades of physical securities may require that paper instruments move between institutions, while trades of book-entry securities only involve changes in computer account entries.

Physical Securities At present, bankers acceptances, large certificates of deposit (CDs), and some commercial paper issues are issued in physical form; that is, they use paper certificates to represent the obligation of the issuer to the purchaser. Clearing physical securities works as follows. Suppose Hoozon First Securities decides to purchase $10 million of CDs from Watson Second Securities. Suppose also that Hoozon uses Downtown as its clearing bank and Watson uses Midtown. After the securities firms' back offices notify their clearing banks of the trade, Midtown pulls the CDs from the vault and a courier delivers them to Downtown. Downtown then sends over Fedwire $10 million in payment to Midtown. Downtown charges Hoozon for the payment while Midtown credits

[4] Correspondent banks perform services for other banks in return for fees or minimum deposit balances.

Watson. The trade between the dealers has been cleared and settled. If Hoozon then sells $5 million of the CDs it bought to Zippi Industries, one of its corporate customers, and if Crosstown National serves as Zippi's custodian bank, it will be necessary for Downtown to deliver the securities to Crosstown for safekeeping and for Crosstown to make a payment to Downtown.

A dealer might elect to clear securities itself. In the above example, self-clearing would mean that securities would be moved directly between the dealers (or between a self-clearing dealer and a clearing bank). Whether a dealer clears for itself or uses a bank depends on whether or not the additional costs of running a clearing operation outweigh the benefits of possibly faster clearing and greater control over the operation. But even if a dealer clears for itself, it will still use a bank for settlement because only banks (or, more accurately, depository institutions) have accounts at the Federal Reserve.[5]

Physical securities by their nature involve handling and delivery costs as well as risks of theft. Consequently, there are incentives for keeping (or "immobilizing") physical securities in depositories instead of requiring that the securities be physically moved each time they are traded. When a security held in a depository is sold, the depository's files are updated to reflect the change of ownership. In other words, a depository effectively converts an exchange of physical securities into an exchange of book-entry securities (McAndrews 1992). Taking the process one step further, the physical security can be eliminated altogether (or "dematerialized"), and the security can be issued, cleared, settled, and redeemed in book-entry form on the computer files of the depository. As more types of money market instruments become eligible for conversion to book-entry form, cost considerations could quickly turn physical securities into an anachronism.

Book-Entry Securities Money market instruments have been moving from physical to book-entry form by means of depositories. In particular, the Depository Trust Company (DTC), a New York limited-purpose trust company owned jointly by banks, broker-dealers, and other financial organizations, has been active in making more instruments eligible for conversion to book-entry form. The movement to book entry has been rapid. Municipal securities became eligible for book entry in 1981; by the end of 1991, 77 percent of the value of municipal notes outstanding was issued through DTC in book-entry form and involved no physical securities (DTC 1991). Commercial paper became eligible for book entry in 1990; by May 1992, 42 percent of the value of the commercial paper market was issued through DTC entirely in book-entry form. And as of this writing, DTC was attempting to make large CDs and bankers acceptances eligible for book entry.

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[5] A dealer could avoid using banks for settlement if it physically delivered cash in payment for securities. Transportation costs and theft risks ensure that virtually all payments take place through banks.

U.S. government securities, including Treasury bills, are now issued only in book-entry form. That is, instead of being represented by paper certificates, obligations of the United States are now recorded as entries on the computer files of the Federal Reserve Banks and commercial banks. The Treasury and Federal Reserve System completed a switch to book-entry securities in 1986 because of concerns about security and the costs of processing and moving huge quantities of paper instruments.

Every Treasury security issue is represented by an entry on a Federal Reserve Bank's computer. The Fed keeps track of which bank holds a particular portion of an issue and, at maturity, transfers funds in repayment to the bank holder. But while the Fed maintains securities accounts in order to keep track of the outstanding issue balance, the accounts do not show up on the Fed's balance sheet. Rather, they reflect the Fed's custody of the Treasury security issue for the various depository institutions. Similarly, when a bank purchases a Treasury security for the account of a customer, the bank is not the actual owner even though the Fed's computer assigns a security balance to that bank.

Now for a transaction. Say that the Bank of Downtown purchases $10 million of Treasury bills from Midtown Trust. When the securities are transferred over Fedwire, two offsetting transactions take place simultaneously: the exchange of securities and the exchange of funds in payment. The movement of Treasury bills takes place by decreasing Midtown's book-entry securities account at the Federal Reserve Bank and by increasing Downtown's by the same amount. Payment occurs as shown in Table 1 and involves a transfer of funds from Downtown's reserve account to Midtown's. Because funds and securities are transferred at the same time, such a system is called a "delivery versus payment" system.

The preceding example only shows what would happen if the purchasing bank were holding the securities for its own account. Now, suppose that Hoozon First Securities purchases the $10 million of Treasury bills from Watson Second Securities. If Hoozon uses Downtown as its clearing bank and Watson uses Midtown, Downtown increases Hoozon's securities account by $10 million and decreases its funds account by the same amount in payment. At the other end, Midtown decreases Watson's securities account and increases its funds account by $10 million. On Fedwire the securities move from Midtown to Downtown and the payment moves in the opposite direction. Note that actual ownership of the security moves from Watson to Hoozon and does not rest with either bank. The banks and the Federal Reserve are simply the conduit through which ownership of securities is passed.

EURODOLLARS

Trades involving Eurodollar deposits differ from those of domestic instruments in that they entail corresponding transactions in the United States and overseas and also are likely to involve the CHIPS and SWIFT networks. Eurodollar deposits

are dollar deposits held outside the United States in either a foreign bank or an overseas branch of a U.S. bank. Inside the United States, Eurodollars can be held only by international banking facilities of domestic or foreign banks. When Eurodollar deposits move between banks, they normally involve corresponding entries on the balance sheet of some organization located in the United States.

Table 4 shows an example in which the Bank of Downtown raises $10 million of interbank deposits from London Bank in the Eurodollar market; the transaction takes place through Downtown's London branch.[6] Because London Bank is not headquartered in the United States, any dollar-denominated transaction in which it engages must ultimately go through a correspondent bank in the United States. London uses Midtown Trust as a correspondent, so the transfer occurs through London's account at Midtown and then through Midtown's and Downtown's reserve accounts at the Federal Reserve Bank.

Once Downtown and London have agreed to the transaction, London sends Midtown a transfer message over the SWIFT network instructing that its balance with Midtown be decreased by the amount of the transfer. In carrying out the transfer of reserves to Downtown, Midtown would normally use the CHIPS network. The transaction is settled at the end of the day when CHIPS goes through net settlement and reserves are transferred from Midtown to Downtown.

There are specialized networks and facilities for clearing and settling other Eurodollar instruments. For example, Euro commercial paper, Euro-notes, and Eurodollar CDs are commonly cleared and settled in both the Euroclear and CEDEL systems. Euroclear, originally formed to clear Eurobond trades, is owned by a Belgian cooperative and operated under contract by the Brussels branch of Morgan Guaranty Trust Company. Securities are immobilized in a network of depositories and settled in book-entry form; funds transfers in connection with book-entry settlement take place through deposits on Morgan's books.

CEDEL is a Luxembourg corporation, specially chartered as a clearing organization. As with Euroclear, securities settled over CEDEL are immobilized in depositories; unlike Euroclear, funds transfers in connection with book-entry securities settlement take place through deposits with the CEDEL clearing organization itself.

Finally, Eurodollar instruments can be cleared and settled by banks. For example, the First National Bank of Chicago operates the First Chicago Clearing Centre in London in order to provide custodian, agent, and clearing bank services for Eurodollar instruments, primarily dollar-denominated CDs. Funds transfers associated with movements of Eurodollar instruments take place on the books of First Chicago's London branch.

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[6] The London branch's account with Downtown's headquarters bank in the United States is carried on the liability side of the U.S. bank's books as "due to" its branch and on the asset side of the London branch's books as "due from" its parent bank.

TABLE 4

Settlement of a Eurodollar Funds Purchase

(in millions of dollars)

Bank of Downtown, London Branch		London Bank (U.K.)		Bank of Downtown (U.S.)	
Assets	**Liabilities**	**Assets**	**Liabilities**	**Assets**	**Liabilities**
Account at U.S. office +10	Deposit, London Bank +10	Deposit, Midtown Trust -10 Deposit, Bank of Downtown +10		Reserves +10	London Branch account +10

Midtown Trust (U.S.)		Federal Reserve Bank	
Assets	**Liabilities**	**Assets**	**Liabilities**
Reserves -10	Deposits, London Bank -10		Reserves, Bank of Downtown +10 Reserves, MidtownTrust -10

RISK AND RISK CONTROLS[7]

Given the daily volume and value of transactions that occur in the money market, the opportunities for loss as the result of default or operational problems are potentially huge. Consequently, over the last decade both market participants and regulators have devoted a great deal of effort to formulating policies for keeping risks within acceptable limits.

Policy discussions often distinguish among several forms of risk (Parkinson et al. 1992). First, credit risk refers to potential losses arising from a clearing and settlement system participant defaulting on some or all of its settlement obligations. Second, liquidity risk arises from the possibility that settlement could be delayed because of temporary unavailability of funds. The distinction between credit risk and liquidity risk lies in the temporary nature of illiquidity as opposed to the permanent nature of default. Third, systemic risk refers to the danger that the failure of one participant to settle its obligations could lead to liquidity problems or settlement failure on the part of others. Finally, operational risk stems from the possible breakdown of computer systems or other elements of the clearing and settling mechanism.

Fedwire provides the most transparent example of credit risk. The Fedwire transaction shown in Table 1 omits an important point: In order for the transfer to take place, it is not necessary that the sending bank always have sufficient funds in its reserve account to cover the transfer.[8] If at the time of the transfer in Table 1 the Bank of Downtown has only $5 million on deposit as reserves, Downtown incurs a "daylight overdraft" of $5 million. That is, its reserve account is allowed to go negative during the day so long as the deficit is made up before close of business. Further, the receiving bank will have final payment at the time of the transfer regardless of whether the overdraft is ultimately covered. Until the overdraft is covered, the Federal Reserve Bank assumes the credit risk of Downtown's failing to provide the necessary funds. While credit risk has effectively been socialized by transferring it to the Fed, systemic risk has been eliminated because there is no avenue for losses to spread to other banks in the system.

On CHIPS, credit, liquidity, and systemic risks can all arise. For example, suppose the Bank of Downtown receives a CHIPS transfer message from Crosstown National for a payment to one of its corporate customers. Although CHIPS does not settle until the end of the day, it may be Downtown's practice to allow its customer to withdraw the funds prior to settlement. In allowing such access to funds, Downtown assumes the risk that Crosstown might fail to meet its net settlement obligation at the end of the day. More serious, the failure of Crosstown

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[7] For more comprehensive discussions, see Group of Thirty (1989), Juncker, Summers, and Young (1991), and Parkinson et al. (1992).

[8] Exceptions to this general rule include weak institutions whose overdrafts are either prohibited or monitored in real time.

to settle a particularly large net debit position could conceivably cause a chain reaction of settlement failures among other participants, some of which might depend on the receipt of payments from the failing bank in order to fund their obligations (Humphrey 1986). Measures to control such risk will be discussed presently.

Finally, operational risks may be illustrated with the following incident that occurred in 1985. The Bank of New York, acting as a clearing bank for book-entry Treasury securities, had an internal computer problem that allowed the bank to accept securities but not to process them for delivery to dealers, brokers, and other market participants. The bank's reserve account was debited for the amount of the securities, but the bank was unable to re-send them and collect payment. The result was a growing daylight overdraft in the Bank of New York's reserve account. As it became increasingly clear that the problem would not be fixed by close of business, the bank borrowed from the discount window. The problem was fixed during the night so the loan was repaid the following day.

As one might guess, the above risk categories overlap considerably. For example, operational problems at a bank could lead to liquidity problems, which in turn might cause systemic problems with other banks. In addition, operational problems could extend to accounting systems and thereby make it difficult for system participants to monitor their credit exposures to other participants. Finally, at the time a participant fails to meet its settlement obligations, the other participants are unlikely to be able to determine whether the problem is the result of default or illiquidity. Still, the distinctions are important to policymakers because each category of risk requires different solutions. For example, operational risks might lead to policies designed to create incentives to develop backup facilities and procedures to keep systems running, credit risks might suggest loss-sharing arrangements and limits on risk exposure, and liquidity risks might call for emergency lending arrangements.

Risk-control measures cover a wide spectrum. The simplest are membership standards, which seek to head off settlement problems by excluding from a system those participants lacking the financial strength and operational expertise to assure that settlement obligations can be met. Once a participant is admitted, the clearing organization should monitor the participant's financial condition to ensure that it does not pose losses to the other members.

Another form of risk control is quantitative limits on risk exposure. Examples include net debit caps and bilateral net credit limits. Net debit caps are limits on the size of a bank's combined daylight overdraft on Fedwire and net debit position on CHIPS. In other words, they attempt to control the risk a bank poses to the payment system by limiting how much a bank can, on balance, owe others over the wire transfer networks. Bilateral net credit limits specify the maximum net transfer a bank on CHIPS is willing to receive from a particular sending bank; that is, they provide a means for a bank to control its own exposure to other

banks. Net debit caps on Fedwire and CHIPS and bilateral net credit limits on CHIPS were part of the original Federal Reserve risk-control policy adopted in 1986.

Risks to a clearing and settlement system can also be limited by requiring system participants to put up collateral to cover their obligations to the system. If a participant defaults, the collateral is used to cover the losses. In effect, such a requirement amounts to a performance bond that a participant forfeits if it defaults on its settlement obligations.

A form of risk-control policy that seeks to create economic incentive to control risks is explicit pricing of daylight overdrafts (Mengle, Humphrey, and Summers 1987). The rationale for pricing is that it will impose a cost on using intraday credit and thereby provide incentives to reduce risk exposures and to more efficiently allocate intraday credit. In 1992 the Federal Reserve approved a charge on daylight overdrafts that exceed 10 percent of an institution's risk-based capital. By 1996 the charge will be $6.85 per day per $1 million (that is, an annual rate of 25 basis points) of average Fedwire daylight overdrafts arising from funds transfers and book-entry securities transfers that exceed 10 percent of an institution's risk-based capital.

A fifth form of risk-control policy is loss sharing among members of a net settlement system. Under a loss-sharing agreement, banks that are members of a system share the losses caused by another member's failure to settle. A loss-sharing agreement generally requires two characteristics to make it work. The first is settlement finality, that is, assurance that settlement entries will not be reversed in the event of one bank's failure to settle. Second, in order to make the loss-sharing agreement credible, banks are generally required to contribute collateral to a clearing fund, which can be drawn upon in the event of a settlement failure and can also serve as security for an emergency line of credit. By imposing costs on system participants if a failure occurs, a loss-sharing agreement can create incentives for banks to monitor the soundness of other banks in the system. CHIPS adopted settlement finality and a loss-sharing agreement in 1990.

A sixth means of risk control is obligation netting, that is, combining a set of offsetting gross payment of securities obligations into net obligations (see box, "Netting and Net Settlement"). Netting, be it bilateral or multilateral, can reduce operational risks by reducing the volume of transactions that actually pass through a clearing and settlement system. And provided that the underlying legal obligations between participants are netted along with the positions, netting can reduce credit risks between banks by reducing the total amount of funds and securities that actually must be transferred between banks (Gilbert 1992).

The Government Securities Clearing Corporations (GSCC) was established in 1986 to provide netting of government securities trades for banks and other securities brokers and dealers. It works as follows. Participants submit data on all securities transactions to be settled on a particular day. First, the trades are

compared. Then, each participant's transactions of each issue are added up into a net credit or debit security settlement position for each issue and a single funds settlement position. The netting process is the same as the multilateral arrangement shown in the box, except for GSCC the numbers would refer to sales or purchases of a specific issue of government securities instead of CHIPS funds transfers. Settlement occurs over the Fedwire book-entry system: Clearing banks deliver (against payment) net securities positions to GSCC; in turn GSCC sends (against payment) the netted amounts of each issue to receivers.

While netting can reduce operational risks as well as credit risk, it has the potential to increase systemic risk. In response to concerns about systemic risk, the GSCC has adopted three measures to deal with the default of a participant. First, GSCC requires that members contribute to a clearing fund. Second, it maintains a line of credit on which to draw in the event of liquidity problems. Finally, it has in place rules for sharing losses in the event of a default.

A final means of reducing risk, one that is applicable to systems for clearing and settling securities, is moving securities to book-entry, delivery-versus-payment form. Delivery versus payment helps reduce credit risk exposure because making the exchange of funds and securities simultaneous (or nearly so) eliminates (or greatly reduces) the time between delivery of securities and payment of funds during which a participant could fail to meet its obligation. In addition, book entry reduces operational risks by eliminating physical delivery of instruments.

While book entry and delivery versus payment reduce exposure to a defaulting participant, they do not eliminate it entirely. In order to provide additional protection against losses if a participant defaults, the Federal Reserve has issued guidelines for risk controls on privately operated book-entry systems (*Federal Register,* June 21, 1989). A specific example of such controls is in DTC's book-entry commercial paper facility. DTC's safeguards include a clearing fund contributed to by participants, net debit caps and a requirement that a participant maintain collateral on its net debit position (*Federal Register,* October 17, 1990).

To some extent designing a program for risk reduction entails trade-offs between various types of risk. For example, until 1981 CHIPS did not settle until the day after the transfer messages were made. That gave rise to overnight credit risk. When CHIPS moved to same-day settlement, credit risk was reduced (or made shorter in duration), but operational risk most likely increased, at least temporarily, since there was less time to prepare for settlement. In practice, the challenge in developing new clearing system technologies is to reduce credit and systemic risks while avoiding operational risks.

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