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# Recent Developments in Wholesale Payments Systems

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Payments systems can be divided conceptually into two components: retail and wholesale. The retail payments system, used primarily by nonbanks for making and receiving payments, involves relatively small transfers of monetary value. In contrast, the wholesale system, which banks use to make payments to each other, involves relatively large transfers.[1]

The Bank for International Settlements (BIS) in Basle, Switzerland (a consultative forum for major central banks) has recently published a series of reports covering various aspects of the wholesale payments system,[2] the purposes of which are, first, to inform central bankers and payments-system participants about current practices in wholesale payments systems, and second, to provide a central-bank perspective on how various changes to these practices could enhance the safety and efficiency of wholesale payments systems. This article summarizes the reforms to G-10 wholesale payments systems documented in and spurred by this series of BIS reports.

One general approach has been to strengthen (or "secure") existing payments system arrangements based on net settlement.[3] Net settlement systems accumulate a record of financial obligations among participants over a prespecified period of time, such as a business day, at the end of which the net amount of funds, securities, or other financial obligations owed by or to each participant is transferred. The primary shortcoming of traditional "unsecured" net settlement systems is that not only do they expose their own members to the risk of default by other members, they also expose financial institutions and other creditors outside the netting system. The danger is that liquidity or solvency problems will thus be transmitted quickly and unpredictably throughout the global financial system.

"Secured" net settlement systems, on the other hand, are designed so that any disruptions caused by a single member (even if this happens to be the institution with the largest net obligations to other members) can be absorbed by the system and its members with no risk of further propagation. To achieve this goal, such systems require that members undertake extensive and perhaps costly risk-management measures. These measures typically include real-time monitoring of counterparties within the system, net debit caps, collateralization, and additional open-ended financial guarantees in case all other safeguards prove inadequate.

Another approach to strengthening wholesale payments systems involves greater private-sector use of gross settlement. Gross settlement systems include real-time gross settlement payments systems (RTGS), delivery-versus-payment (DVP) systems, and payment-versus-payment (PVP) systems. Recently, many central banks have created new RTGS systems or improved their existing ones to strengthen their wholesale payments systems. In contrast to unsecured net settlement systems, gross settlement systems can eliminate virtually all repercussions to other private-sector members when one institution encounters difficulty. There is a cost, however. Depending on its structure, a gross settlement system may impose significant liquidity demands on participants, or it

[1] See Emmons (1996) for an overview of the retail payments system in the United States. See Humphrey, Pulley, and Vesala (1996) for a comparison of G-10 countries' retail payments systems or Bank for International Settlements (1993b) for details on both retail and wholesale components of payments systems in the G-10 countries.

[2] Bank for International Settlements, 1989, 1990, 1992, 1993a, 1993b, 1995a, 1996, 1997a, 1997b.

[3] "Secured" net settlement systems (discussed later in this article) are those that can withstand the failure of the member financial institution with the largest amount due to other members of the system.

may require that the central bank incur substantial supervisory and risk-management costs in the process of alleviating liquidity burdens.

Most G-10 central bankers believe that, despite their costs, gross settlement systems will be important components of wholesale payments systems in the future. Why, then, have private-sector financial institutions very often chosen to upgrade and secure existing net settlement systems instead of moving more rapidly to gross settlement systems? Could (and should) central banks do more to facilitate a more widespread and rapid transition to gross settlement systems?

This article does not provide definitive answers to these questions. Instead, I offer an overview of recent developments in large-value gross and net settlement systems in the G-10 countries. In the first section, I discuss gross settlement systems, including RTGS systems, for large-value funds transfers; DVP systems, for securities; and PVP systems, for foreign-exchange settlement. The second section discusses net settlement systems and explores several related issues, including the risk that netting agreements may not be legally binding in all jurisdictions and the possibility that liquidity or solvency problems could spill over from one financial institution to another and, in turn, to the financial system as a whole, creating a situation termed systemic risk. The third section concludes with a few tentative hypotheses regarding the relatively slow movement to date of wholesale payments and settlement activity to gross settlement systems.

## GROSS SETTLEMENT SYSTEMS

"Federal Reserve Updates Payments-System Risk Policy, Implements Pricing on Fedwire."

"European Central Banks Reach Outline Agreement on TARGET."

"Bank of Japan to Convert BOJ-Net to Real-Time Gross Settlement Exclusively."[4]

The common theme in these fictional but representative headlines is a desire on the part of G-10 central banks to influence private-sector behavior in wholesale (large-value) payments systems. In particular, central banks have encouraged the use of real-time gross settlement payments systems and trade-by-trade securities and foreign-exchange settlement systems. This situation has occurred because there is virtual agreement among major central banks that gross settlement systems make wholesale payments systems more immune to widespread financial disruption, a key determinant of economic stability and efficiency.

### *Key Design Issues in Real-Time Gross Settlement Systems*

Real-time gross settlement systems are large-value funds transfer services that operate continuously during the business day to provide irrevocable settlement of payments obligations in central-bank money. Irrevocable funds transfers on RTGS systems occur when a central bank debits the reserve account of the payor and credits the account of the payee. This transfer of value from payor to payee is simultaneous and final (i.e., not subject to reversal for any reason). If the funds transfer occurs (at least in principle) at the time the instructions of the payor are transmitted to the central bank, then it is said to occur continuously, or in "real time."

Central banks provide RTGS systems to commercial banks and other selected institutions such as government agencies and, in some countries, clearing houses for securities and derivatives exchanges (Bank for International Settlements, 1997a, pp. 33-7; Bank for International Settlements, 1997b, p. 14). Funds transfers over RTGS systems may be for millions of dollars or the local-currency equivalent, although these systems also handle smaller payments.

The design and operation of RTGS systems differ considerably from one country to another. Two important dimensions along which currently operating or

[4] Fedwire (the Federal Reserve's Fedwire Funds Transfer Service), TARGET (the Trans-European Automated Real-time Gross Settlement Express Transfer System), and BOJ-Net (the Bank of Japan's large-value funds transfer service) are all real-time gross settlement (RTGS) systems.

Table 1

### Intraday Credit Policies and Centrally Located Queues in G-10 RTGS Systems

| Countries Whose RTGS Systems Provide: | Centrally Located Queue | No Centrally Located Queue |
|---|---|---|
| Central bank intraday credit | Belgium<br>France<br>Germany<br>Italy<br>Netherlands<br>Sweden | United Kingdom<br>United States |
| No central bank intraday credit | Switzerland | Japan |

No RTGS system: Canada.

SOURCE: Bank for International Settlements (1997a, Table 3, p. 13).

proposed RTGS systems differ are (1) policies toward the granting of central bank intraday credit and (2) the existence and management of queues (see Table 1). Intraday credit is valuable in an RTGS system because it can reduce payment blockages that may arise as one bank's outgoing payment awaits an incoming payment from another bank, which may, in turn, be waiting on a payment from a third bank. Payments may become blocked in RTGS systems because of the "cover principle" in gross settlement systems: An outgoing payment order is executed if and only if the sending bank currently has sufficient reserves, or cover, in its reserve account at the central bank.

The worst case of uncoordinated payment demands is gridlock, in which no bank can make a payment through an RTGS system because all reserve balances are held by banks due to receive payments from others. Although unlimited central bank intraday credit would eliminate gridlock, it is not offered in any RTGS systems because such a policy would create moral hazard, in that banks might tend to manage their intraday liquidity less intensively. Such a situation could give rise to an acute liquidity crisis, into which central banks would need to intervene in their role as lender of last resort. Ample availability of central bank intraday credit could also hamper the emergence of intraday money markets, which are, in principle, a necessary component of a complete and efficient set of financial markets.

Despite the fact that all RTGS systems are capable of operating continuously, some payment orders in some RTGS systems are not carried out immediately. For example, when a sending bank has insufficient funds in its reserve account and central bank intraday credit is not available, either temporarily for that bank or as a matter of system design, a payment order will not be executed. A pending payment order is subject to two different responses by central banks.

The payment order may be rejected outright, in which case the sender may enter it into an "internal queue" that assigns priority to outgoing payments. Selected payment orders are then resubmitted to the RTGS system when sufficient covering funds in the bank's reserve account become available, either from payments received or via borrowing from another bank.

Alternatively, a payment order that cannot be executed because of insufficient reserve funds may enter a "centralized queue" maintained by the central bank. That is, rather than returning the payment order unexecuted to the sending institution,

Table 2

Real-Time Gross Settlement (RTGS) Systems in G-10 Countries

| Country | Name of RTGS System | Year of Implementation |
|---|---|---|
| Belgium | ELLIPS | 1996 |
| Canada | — | — |
| France | TBF | 1997 |
| Germany | EIL-ZV | 1988 |
| Italy | BI-REL* | 1997 |
| Japan | BOJ-NET | 1988 |
| Netherlands | TOP* | 1997 |
| Sweden | RIX | 1986 |
| Switzerland | SIC | 1987 |
| United Kingdom | CHAPS | 1984 |
| | Euro version of CHAPS | 1999 |
| United States | Fedwire | 1918 |

*BI-REL and TOP replace previously existing RTGS systems BISS (implemented in 1989) and FA (implemented in 1985), respectively (Bank for International Settlements, 1993b, pp. 218-19, 302-5).

SOURCE: Bank for International Settlements (1997a), Annex 1.

the central bank may retain all payment orders that require incoming cover in a centrally located computer file. When adequate reserves become available to execute any of the queued requests, the central bank then reenters the payment order into the system.

A centrally located and managed queue can facilitate an orderly flow of payments because the system operator can identify payment requests that will offset each other to some extent. That is, one payment provides cover for the next, which provides cover for the next, and so forth. This type of oversight and queue management is termed "optimization" (Bank for International Settlements, 1997a, pp. 24-7).

The existence of a centralized queue and optimization routines may discourage intensive management of intraday liquidity by banks. These factors may also encourage banks to anticipate payments (i.e., credit the accounts of depositors to whom queued payments are directed before final settlement actually occurs). Unfortunately, the practice of systematically anticipating payments that are being held in queues tends to increase systemic interdependence and settlement risk—precisely the problems that RTGS systems are designed to eliminate.

## Overview of RTGS Systems in G-10 Countries

Table 2 lists the RTGS systems currently in operation or in preparation in the G-10 countries. The Federal Reserve's Fedwire funds-transfer service is the oldest RTGS system in the world. Since 1984, RTGS systems have been introduced by all other members of the G-10 group of countries except Canada. Other European Union countries (i.e., those not in the G-10) that hope to participate in the initial launch of the European single currency in 1999, including Greece, Spain, Ireland, Luxembourg, Austria, Portugal, and Finland, are also developing RTGS systems (European Monetary Institute, 1996). Other countries that have recently introduced RTGS systems or plan to do so include the Czech Republic, Hong Kong, Korea, Thailand, Australia, China, New

Zealand, and Saudi Arabia (Bank for International Settlements, 1997a, p. 1).

The Federal Reserve System's Fedwire Funds Transfer Service (commonly known as "Fedwire") began operations in 1918 and was converted to a fully computerized, high-speed electronic telecommunications and processing network in 1970 (Bank for International Settlements, 1997a, p. 12). In addition to upgrading Fedwire technical and communications capabilities, the Federal Reserve has also implemented a series of measures to improve Fedwire risk management in recent years (Richards, 1995; Hancock and Wilcox, 1996). One focus of these efforts has been to reduce banks' daylight overdrafts (short-term credit extensions by the central bank) on Fedwire (see shaded insert: "Federal Reserve Attempts to Limit Daylight Overdrafts on Fedwire").

RTGS systems in European G-10 countries differ among themselves but generally fall into two categories according to whether or not the country expects to participate in the initial phase of European Economic and Monetary Union (EMU) beginning in 1999. Those countries that plan to participate (Belgium, France, Germany, Italy, and the Netherlands) have conformed their RTGS systems to a common set of standards to facilitate their interlinking in the TARGET system. In particular, fairly liberal policies toward central bank intraday credit and centralized queuing facilities are envisioned for participating RTGS systems. Both of these features enhance the liquidity of RTGS systems. In contrast to Fedwire, the EMU systems will not assess charges for daylight overdrafts, although such borrowings must be fully collateralized in order to protect the fledgling European System of Central Banks against credit risk posed by individual banks (Bank for International Settlements, 1997a, pp. 12-3). European G-10 members that do not plan to participate in EMU at the outset include the U.K. and Switzerland (not a member of the European Union). Liquidity-enhancing measures in these countries' RTGS systems (particularly in Switzerland) are not as liberal as those of the other European countries mentioned above, as the discussion below will make clear.

The Bank of Japan is prepared to go further than any other G-10 central bank in forcing the pace of change toward RTGS systems. Currently, banks may submit payments to BOJ-Net to be settled at 9:00 a.m., 1:00 p.m., 3:00 p.m., or 5:00 p.m. on a net basis; or payment orders may be submitted for immediate execution via the RTGS mode of BOJ-Net. The BOJ announced at the end of 1996 that it will phase out the net settlement capability of BOJ-Net by the year 2000 (Matsushita, 1997). Thereafter, real-time gross settlement will be the only mode of settlement available via BOJ accounts. This is a significant policy decision, because designated-time net settlements accounted for 98.8 percent of volume and 99.9 percent of value on BOJ-Net in 1995, while RTGS accounted for the remainder (Bank for International Settlements, 1997a, Annex 1).

In sum, there appears to be no international consensus regarding the optimal design of an RTGS system. This conclusion is not surprising when one takes into account significant cross-country differences in central-bank preferences, locally prevailing cash-management technologies, availability of collateral, and securities market liquidity (Furfine and Stehm, 1996). All existing systems appear to be a compromise between objectives that sometimes conflict among banks and institutional constraints that may be evaluated differently by different central banks.

## *The Role of Intraday Credit in RTGS Systems*

Some RTGS systems allow participating banks to send payments with finality for amounts greater than their reserve balances immediately prior to the time of the request. In carrying out such a payment request, the central bank extends a short-term loan to fund the reserve account of the sending bank. Since all central banks that grant such credit extensions require repayment by the end of the business day, these loans are termed daylight overdrafts.[5]

[5] All G-10 central banks provide overnight lending facilities, some of which can be accessed during the business day (Bank for International Settlements, 1997a, Annex 1, Part II). Without exception, banks find them relatively unattractive sources of intraday funds to meet payments obligations.

## FEDERAL RESERVE ATTEMPTS TO LIMIT DAYLIGHT OVERDRAFTS ON FEDWIRE

For more than 10 years, the Federal Reserve has undertaken a campaign to induce banks to control the amount of their daylight overdrafts on Fedwire. While Fed policymakers have long believed that relatively liberal provision of central bank intraday credit on Fedwire was appropriate (Board of Governors of the Federal Reserve System, 1988, p. 50), they also felt that some form of market discipline or regulatory restraint on daylight overdrafts could improve the allocative efficiency of such credit without sacrificing its overall benefits in terms of enhancing the system's liquidity. The impetus for Federal Reserve action to limit Fedwire daylight overdrafts stemmed from three considerations (Richards, 1995, pp. 1066-67):

First, large daylight overdrafts create the potential for large demands for overnight borrowing, thereby complicating the conduct of monetary policy. Since daylight overdrafts are unsecured, but overnight discount-window loans must be secured, a large overhang of daylight overdrafts that cannot be repaid by day's end could create disorderly conditions in the Federal funds and securities markets as reserves and collateral are sought to eliminate or secure Federal Reserve lending. Alternatively, such an overhang could force the Fed to allow some uncollateralized overnight overdrafts, thus violating its own risk-management policies.

Second, the Fed became increasingly aware in the 1980s of the substantial credit risk associated with unsecured daylight overdrafts. The Fed guarantees all payments made on Fedwire, so unlimited, unpriced, unsecured overdrafts allowed sending banks to appropriate the Federal Reserve's unsurpassed credit rating at no cost to themselves.

Finally, the Fed began to recognize more clearly that substantial daylight overdrafting on private large-value transfer systems put the payments system as a whole at risk. In order to control the risk in parts of the wholesale payments system over which the Fed had only indirect influence—such as CHIPS[†]—it was necessary to accumulate experience and demonstrate progress in managing risk where the Fed *did* maintain control, namely, on Fedwire. Controlling daylight overdrafts on Fedwire was a step toward implementing sound intraday credit policies throughout the wholesale payments system.

The Federal Reserve imposed net debit caps on daylight overdrafts in March 1986 and began charging explicit fees for daylight overdrafts in accounts at Federal Reserve Banks in April 1994 (Hancock and Wilcox, 1996, pp. 873-76). The Fed also uses real-time monitoring for "problem" institutions and requires these and selected other Fedwire participants to post collateral for daylight overdrafts. Net debit caps were tightened and adjusted several times subsequent to their introduction, while overdraft fees were increased in April 1995. Empirical evidence indicates that these measures—especially overdraft fees—have been effective in curtailing certain banks' use of daylight overdrafts on Fedwire (Hancock and Wilcox, 1996, pp. 906-7).

[†] CHIPS (Clearing House Interbank Payments System) is a net settlement system operated by the New York Clearing House Association. See section on net settlement systems for details.

There are several basic models for daylight overdraft privileges on RTGS systems (Bank for International Settlements, 1997a, pp. 14-21 and Annex 1, Part II). Among G-10 RTGS systems, daylight overdrafts on Fedwire within a bank's net debit cap are unusual in that they do not generally require specific collateral backing.[6] This feature is advantageous to banks, which typically do not need to hold or

[6] Each bank's net debit cap is set as a multiple of its regulatory capital. Branches or agencies of foreign banks, domestic financial institutions that have been identified by the Federal Reserve as troubled, and non-bank financial institutions that provide overdraft funding of securities activities for affiliates must provide collateral for overdrafts. Collateral is also required for frequent and material overdrafters. In total, more than 50 percent of all intraday credit extended by the Fed is collateralized.

manage significant amounts of reserves or collateral for payments purposes. Another unusual aspect of daylight overdrafts on Fedwire is explicit volume-based pricing. The Federal Reserve charges an annualized rate of 15 basis points on the daily average overdraft in excess of the bank's deductible amount, which is 10 percent of its regulatory capital. Only about 90 financial institutions typically incurred overdraft fees of more than $100 in any two-week period in 1995 (Richards, 1995, p. 1072), so Fedwire overdraft fees do not constitute a large explicit cost for intraday credit.[7] Given the existence of some amount of unpriced, uncollateralized daylight credit (up to the amount of a bank's net debit cap) and low explicit costs for overdrafts in excess of an institution's deductible, the Federal Reserve's intraday credit policy could be termed relatively liberal, overall.

Another model for central-bank extensions of intraday credit requires a borrowing bank to fully collateralize the overdraft.[8] This approach is typical of existing or planned European RTGS systems that permit daylight overdrafts. Quantitative limits on overdrafts apply in Belgium and Italy but not in Germany, the Netherlands, or Sweden (Bank for International Settlements, 1997a, Annex 1, Part II).

Intraday credit in the U.K. and France is available not through daylight overdrafts per se but rather through intraday sale and repurchase transactions with the central bank. This facility was chosen in order to solidify the central bank's legal claim to the securities involved, rather than for any substantive economic reason (Bank for International Settlements, 1997a, p. 13). Similarly, daylight credit for the RTGS component of Japan's BOJ-Net is available exclusively through sale and repurchase transactions. Given adequate supplies of collateral securities in the market, a central bank intraday credit policy involving unpriced but collateralized overdrafts (or sale and repurchase transactions) with no quantity limits or relatively high ones could also be termed fairly liberal, as is the case in the United States on Fedwire.

Finally, Switzerland alone among the G-10 countries with RTGS systems operates a very restrictive policy toward central bank intraday credit. The Swiss SIC system does not allow daylight overdrafts on any basis (collateralized or not), nor does the Swiss National Bank (SNB) provide facilities for intraday sale and repurchase agreements. The only direct liquidity assistance provided by the SNB is collateralized overnight borrowing, which, if it arises from a failure by a bank to produce reserve funds to cover its queued payments, incurs a penalty rate of interest (Bank for International Settlements, 1993b, p. 365).

## Delivery-Versus-Payment (DVP) and Payment-Versus-Payment (PVP) Systems

As part of their overall function of providing bank-to-bank large-value funds transfers, RTGS payments systems frequently constitute one element in a delivery-versus-payment (DVP) settlement system for securities or of a payment-versus-payment (PVP) system for settling foreign-exchange trading obligations (Bank for International Settlements, 1992, p. 15; Bank for International Settlements, 1993a, p. 4). Many new DVP and PVP systems are being planned or discussed (Bank for International Settlements, 1997a, pp. 33-7). The three main models for structuring DVP systems are outlined below (Bank for International Settlements, 1992, pp. 17-24):

**Model 1 DVP Systems.** So-called "Model 1" DVP systems consist of linked gross, simultaneous settlement of a securities transfer (delivery) and the corresponding funds transfer (payment). The Federal Reserve's Securities Transfer Service for U.S. Treasury and agency securities (commonly called the "Fedwire book-entry system") operates on the same principle as RTGS systems for funds transfers. That is, the seller of a security (comparable to the payor of funds above) must post the securities with the system operator before the buyer of the security (comparable to the funds payee above) takes final, irrevocable

[7] Richards reports that a much larger group of banks—about 700—appear to keep their overdrafts within their net debit caps by managing intraday liquidity, thereby avoiding overdraft fees, as well (Richards, 1995, p. 1072).

[8] To be fully effective as a central bank risk-management tool in a real-time payments system, a full-collateralization policy requires a "Model 1" DVP system covering collateral-eligible securities. The point is that collateral securities must be available for real-time pledges, as well.

delivery. The Fed's book-entry and funds transfer services are linked and together constitute a "Model 1" DVP system (Bank for International Settlements, 1992, pp. A322-24).

A few other central banks have developed already or are in the process of developing similar systems. In particular, "Model 1" DVP systems will be critical in providing the future European System of Central Banks (ESCB) with the protection against individual banks' credit risk envisioned in the policy of collateralized intraday overdrafts. Although the ESCB has no plans to establish a Europe-wide gross settlement system for securities, individual national securities settlement systems will be linked with TARGET to establish "Model 1" DVP systems.

**Model 2 DVP Systems.** A "Model 2" DVP system consists of gross settlements of securities transfers, followed at the end of the day by net settlement of funds transfers. The U.K. gilt-edged (Treasury) securities market operated according to this model as of 1992 (Bank for International Settlements, 1992, pp. A319-21). In this type of system, all securities transfers are final when executed during the day. However, the corresponding funds transfers remain provisional until the end of the day, when final settlement occurs on a multilateral net basis. Failure of a bank in a net-debit position on funds transfers (i.e., owing funds after calculation of net funds positions) does not affect the finality of securities transfers that have already taken place.

**Model 3 DVP Systems.** Finally, "Model 3" DVP systems consist of parallel multilateral net settlement of securities and funds transfers. The Bank of Japan's "DVP-NET" is an example of this type of system (Bank for International Settlements, 1992, pp. A37-9). Private DVP systems that follow this model include the Government Securities Clearing Corporation, the National Securities Clearing Corporation, the Depository Trust Company, and the Participants Trust Company in the United States, and Euroclear and Cedel Bank in Europe (Federal Reserve System, 1997). As noted above, final settlement of the net obligations on one or both legs (securities and/or funds) that arise in these systems is typically accomplished via a gross settlement system. This points out an important complementarity that often exists between the various types of DVP systems. "Model 3" DVP systems in the U.S. may use the Federal Reserve's "Model 1" DVP system to provide final settlement of the *net* obligations of participants resulting from multilateral clearing of securities or funds transfers.

**PVP Systems.** PVP systems are analogous to "Model 1" DVP systems because they allow a pair of financial transfers to be settled on a gross basis simultaneously and with finality. The difference is that each leg of a PVP transaction consists of a funds transfer on a different national RTGS funds-transfer system. That is, instead of providing simultaneous transfers of securities and funds in a single currency, PVP systems allow foreign-exchange transactions to be settled with finality in real time. PVP systems could be helpful in reducing foreign-exchange settlement risk, the single largest remaining source of risk in G-10 payments and settlement systems (Bank for International Settlements, 1996, pp. 4-5).

No PVP systems linking national RTGS systems are currently operating or being planned. Although it may appear to be such a system, the TARGET system in Europe will link national RTGS systems operating in the *same* currency, the euro. Therefore, TARGET's interlinking of national RTGS systems will constitute a communications and clearing system only (similar to the financial links between the twelve Federal Reserve Banks in the United States).

Private foreign-exchange netting arrangements provide PVP elements without central-bank involvement in a manner analogous to a "Model 3" DVP system. For example, in a multilateral foreign-exchange netting arrangement that involved ten banks and four currencies, each of the ten banks would be informed at the end of the day of its net position (debit or credit), in each of the four currencies, vis-a-vis the other members. Settlement of each bank's obligation in each currency would then proceed in separate national large-value payments systems (such as CHIPS or Fedwire in the United States) and therefore would not be linked or simultaneous.

A multilateral foreign-exchange netting agreement that nets currency-by-currency reduces overall settlement risk by lowering the amount of each currency owed to or by any given bank. That is, all of a bank's trades involving U.S. dollars covered by the agreement are reduced to a smaller net U.S. dollar amount due or receivable, all of the bank's trades involving deutsche marks are netted to a smaller net deutsche mark amount due or receivable, etc. As in the "Model 3" DVP systems for securities settlement, one could think of this foreign-exchange netting approach as parallel provisional settlement rather than linked final settlement ("Model 1"). Final settlement of the net positions in each currency must still be carried out separately.

Both multilateral and bilateral foreign-exchange netting arrangements currently exist in the United States and Europe. The Multinet International Bank and ECHO (Exchange Clearing House) are multilateral foreign-exchange netting services, while FXNET, S.W.I.F.T. (Society for Worldwide Interbank Financial Telecommunication), and VALUNET provide bilateral netting services for banks engaged in foreign-exchange trading (Bank for International Settlements, 1996, p. 15-16).

A newly formed venture, CLS Services, Ltd., is an important private-sector initiative that will attempt to implement a PVP system that is analogous in some respects to a "Model 1" DVP system but is closer to traditional correspondent banking in other respects. CLS Services, Ltd., which is jointly owned by a group of banks active in foreign-exchange trading, plans to create a subsidiary bank to function as a multicurrency financial institution that can perform simultaneous, matched, "on-us" transfers of various currencies. Formed by the so-called G-20 group of major international banks, this "continuous linked settlement" bank (hence CLS Services) would eliminate the time delay between settlement of the two legs of a foreign-exchange transaction, which is the source of the most serious risk exposures in this market (Bank for International Settlements, 1996, p. 22; "Global Banks," 1997). In addition to being available for direct use by individual trading banks, the CLS bank could also assist netting arrangements such as FXNET and Multinet in discharging the net obligations that remained among participants after netting in individual currencies had occurred.

As in a "Model 1" PVP system, the CLS bank could provide virtually instantaneous confirmations to trading banks in each currency on a gross basis. Settlement would be final, although withdrawals of individual currencies might be delayed by the failure of counterparty banks to fund their CLS accounts with the appropriate mix of currencies. Thus, the CLS bank could not provide unconditional protection against foreign-exchange liquidity risk—as with a true "Model 1" PVP system—because some trades that are settled may not allow counterparties to withdraw specific currencies immediately (Bank for International Settlements, 1996, p. 22).

For example, suppose a Japanese bank and an American bank use the CLS bank for a single foreign exchange trade during one day. The Japanese bank promises to send an American bank yen, and the American bank promises to pay dollars to the Japanese bank. If a sufficient amount of yen is not in its CLS account by the end of the day, the Japanese bank must fund that account with an RTGS transfer to the CLS bank over BOJ-Net. If the Japanese bank is declared insolvent before funding its yen account, the CLS bank might cancel this trade.[9] In any case, if the American bank has been counting on the trade for fulfilling other time-critical obligations, the failure of

[9] This would occur if the CLS bank operated according to the "guaranteed refund system" (Bank for International Settlements, 1996, p. 22). Alternatively, if the CLS bank operated under the "guaranteed receipt system," a member bank could receive yen if and only if it delivered dollars to the CLS bank. The latter system would involve a performance guarantee from the CLS bank requiring capital or loss-sharing commitments by owner banks. At present, it appears likely that the CLS bank will take the latter approach.

its counterparty could create disruptions or delay.

Hence, although the CLS bank could eliminate the settlement and liquidity risks inherent in a large number of foreign-exchange trades, it would not be operating as a true "Model 1" PVP system. Instead, the CLS bank would be acting as a correspondent bank for each of its account holders. Thus, it could not unconditionally guarantee that all foreign-exchange trades would be perfectly liquid. Only central banks with the ability to create unlimited amounts of their own currency can jointly operate a "Model 1" PVP system.

## NET SETTLEMENT SYSTEMS

The principal alternatives to RTGS systems for large-value funds transfers are bilateral correspondent-banking relationships and multilateral deferred net settlement (DNS) systems.[10] Both correspondent banking and multilateral netting systems offset gross payments obligations in order to arrive at a much smaller net settlement obligation.[11] Similarly, the principal alternative to trade-by-trade gross settlement of trades in securities and other financial obligations is a net securities or financial obligation settlement system.

The primary benefit to financial institutions of netting is a reduced need for immediate liquidity or ownership of securities, since final settlement is deferred until the end of the clearing cycle (usually the end of the business day). Because deferral of settlement implicitly requires a financial institution to extend credit to another institution from which it expects to receive funds or securities, longer elapsed periods between settlements also imply greater exposure of individual payee banks to the credit risks posed by their payments counterparties, the payors (Shen, 1997, pp. 48-50). Thus, it is clear that both the primary benefits and the principal costs of netting derive from the use of private credit in settlement activity (see shaded insert: "Private Credit Extensions in Net Settlement Systems").

In addition to creating risky private intraday credit, however, netting arrangements also reduce the absolute amount of settlement activity that must ultimately occur. In general, the longer the period between successive settlements, the greater the reduction in settlement obligations. Consequently, the direct credit exposures that build up over an extended clearing cycle in a netting system are, at the same time, reduced by the process of netting (Board of Governors of the Federal Reserve System, 1988, p. 4). The greater is the amount of two-way trading among a set of counterparties during a clearing cycle (i.e., buying and selling of the same financial instrument), the more likely it is that the risk-reducing aspect of netting will outweigh the risk-increasing nature of deferred settlement. Thus, when bilateral and multilateral netting arrangements are soundly structured in appropriate circumstances, regulators generally welcome them. This conclusion is particularly true today after the decade-long efforts by the Committee on Payments and Settlement Systems of the Bank for International Settlements, and by individual central banks, to upgrade the soundness of existing and proposed multilateral net settlement systems in the G-10 countries.

### *Deferred Net Settlement (DNS) Large-Value Funds Transfer Systems*

Table 3 lists the major DNS large-value funds transfer systems in the G-10 countries. The largest private DNS payments system in the world is the Clearing House Interbank Payments System (CHIPS) in the United States (see Tables 4 and 5). CHIPS is operated by the New York Clearing House Association and includes over 100 domestic and foreign banks as its members. Fedwire, by way of contrast, connects roughly 10,000 financial institutions in the United States to the Federal Reserve and thereby to each other.

Private-sector large-value payments clearing houses like CHIPS are not a prominent feature of the Japanese or most European payments systems, for largely

[10] It is important to note that RTGS and DNS systems are not direct competitors in all respects. DNS systems typically rely on the national RTGS system for final daily settlement of the multilateral net (or "Net Net") obligations incurred by participants in the netting system.

[11] In correspondent banking, one bank holds deposit balances at another (or they hold balances with each other) that can be debited or credited for funds transfers, foreign exchange, securities, derivatives, or other transactions. Accumulated net credits or debits may be settled periodically through transfers of central bank reserves. These relationships are very important in foreign-exchange trading because they form the only link between different national RTGS or DNS systems. For an overview of payments and settlement in the foreign exchange market, see Gilbert (1992). For detailed discussions of market practices and risks in the foreign-exchange market, see Bank for International Settlements (1989, 1990, 1993a, 1996).

## PRIVATE CREDIT EXTENSIONS IN NET SETTLEMENT SYSTEMS

Deferring final settlement requires an implicit extension of credit from payee to payor in net settlement systems. Intraday loans are economically important even though there is no explicit private intraday credit market in most countries. That is, the time value of an intraday loan may be zero (more precisely, no market price exists), but net settlement systems require them in order to function, and lenders in such systems bear the sometimes substantial credit risks imposed by borrowers.

Consider an example in which three banks, called Banks A, B, and C, are the members of a DNS system. They enter payment orders at different times during the business day, which extends from 9:00 a.m. to 5:00 p.m. (the time of each payment request is listed in parentheses in the table below). Final settlement occurs at 5:00 on a multilateral net basis. All three banks know the amount and timing of upcoming payment flows at the beginning of the business day:

| | Receiving Bank (Lender) | | |
|---|---|---|---|
| **Paying Bank (Borrower)** | **Bank A** | **Bank B** | **Bank C** |
| Bank A | | $100 (9:05 a.m.) | |
| Bank B | | | $100 (4:59 p.m.) |
| Bank C | $100 (9:10 a.m.) | | |

Final settlement occurs at 5:00 p.m., so Bank B is effectively lending Bank A $100 during the period from 9:05 a.m. to 5:00 p.m. Typically there is no explicit cost for this intraday credit, although collateral requirements may impose some opportunity cost on the payor. Similarly, Bank C receives an intraday loan of $100 from Bank A between 9:10 a.m. and 5:00 p.m., while Bank B receives an intraday loan of $100 from Bank C between 4:59 p.m. and 5:00 p.m. Viewed at the end of the day, all banks are in an identical position with zero net debits or credits vis-à-vis the system. In other words, no actual payments are required to settle the day's transactions if the netting agreement has legal standing (see the section on the legal status of netting agreements below) or if all banks are solvent at the end of the day.

This end-of-day symmetry masks the fact that Bank B was a net lender to Bank C for most of the business day, whereas it received a promise for $100 from Bank A early in the day. If Bank B had not entered its payment order to Bank C before 5:00 p.m., and had Bank C been unable to settle its resulting net debit of $100, Bank B would be forced to recover its $100 claim against the netting system. Bank C would have a net debit position in the system of $100, so Bank B would have a claim against Bank C and any other resources already committed to support the netting system, such as collateral, capital, or back-up lines of credit underwritten by surviving members. Thus, relatively modest end-of-day net settlement amounts in a multilateral netting system (zero in this example) may disguise substantial intraday credit exposures faced by individual banks.

historical reasons. There are a few exceptions, however. The United Kingdom's Clearing House Automated Payment System (CHAPS) settled large-value funds transfers in pounds sterling on a multilateral net basis between 1984 and 1996. Subsequently, the system became a real-time gross settlement interface between private banks and the Bank of England (European Monetary Institute, 1996, p. 627).

Another private DNS payments system in Europe is the ECU Clearing and

Table 3

Deferred Net Settlement (DNS) Systems in G-10 Countries

| Country | Name of DNS System | Year of Implementation |
|---|---|---|
| Belgium | CH (Clearing House of Belgium) | NA |
| Canada | LVTS (Large Value Transfer System) | 1998 |
| France | SNP (Système Net Protégé) | 1997 |
| Germany | EAF2 (Elektronische Abwicklung Frankfurt) | 1996 |
| Italy | ME (Electronic memoranda); SIPS | 1989, 1989 |
| Japan | Zengin (Zengin Data Telecommunications System); FEYCS (Foreign Exchange Yen Clearing System); BOJ-Net | 1973, 1989, 1988 |
| Netherlands | 8007-SWIFT (Society for Worldwide Interbank Financial Transfers); FA | 1982, 1985 |
| Sweden | — | — |
| Switzerland | — | — |
| United Kingdom | CHAPS (Clearing House Automated Payment System) | 1984 |
| United States | CHIPS (Clearing House Interbank Payments System) | 1970 |
| Cross-border | ECU Clearing System | 1983 |

SOURCES: Bank for International Settlements (1997a), p. 4 and Annex 2; Bank for International Settlements (1995b), Table 10a; Bank for International Settlements (1993b), pp. 305-06; pp. 498-501.

Settlement System operated by the ECU Banking Association (EBA) since 1983 (European Monetary Institute, 1996, pp. 692-96). After clearing interbank payment obligations denominated in ECU (the European Currency Unit, a fixed basket of European currencies) on a multilateral net basis, final settlement takes place in accounts at the Bank for International Settlements (BIS) in Basle, Switzerland. The BIS acts as a correspondent bank for all the clearing banks in the arrangement, who agree to maintain clearing accounts without overdraft features. The private ECU clearing system does not currently meet the Lamfalussy minimum standards for netting schemes.[12] However, reforms including sender caps, liquidity-sharing, and loss-sharing agreements are being implemented to increase the safety of settlement procedures (European Monetary Institute, 1996, p. 695). The EBA plans to convert the ECU clearing system to one that will settle interbank euro payments on a multilateral net basis beginning in 1999, or whenever the single currency is introduced. The new system will be called EURO 1 and is expected to play a role in Europe analogous to that of CHIPS in the United States, providing large-value multilateral net settlement services alongside TARGET, the RTGS system for euro.

Finally, the major banking groups in many European countries (for example, private commercial banks, state-owned savings banks, or co-operative banks) either clear interbank payments through the national central bank or operate their own centralized correspondent (or bankers' banks) that provide clearing and other services to the sector's members (see Bank for International Settlements, 1993b, pp. 166-78, for a discussion of the German case). These private-sector arrangements handle primarily small-value transactions, however.

In Japan, the Foreign Exchange Yen Clearing System (FEYCS) was established in 1980 by the Tokyo Bankers Association (TBA) to handle yen settlement of cross-border transactions, comparable to the role of CHIPS in the United States. However, the TBA transferred the operation of FEYCS

[12] The Lamfalussy standards specify the minimum criteria any private net settlement system must meet to be acceptable to a G-10 central bank (Bank for International Settlement, 1990). See the discussion and Table 6 for an overview of these standards.

Table 4

Milestones in the Development of CHIPS (Clearing House Interbank Payments System)

| Event | Date |
|---|---|
| Computerization of message transfers for participants | April 1970 |
| Paper Exchange Payment System (PEPS) implemented for non-members | March 1972 |
| Larger computer installed; all PEPS-using banks become CHIPS participants | October 1974 |
| Same-day settlement implemented through special reserve account at the Federal Reserve Bank of New York | October 1981 |
| Bilateral credit mechanism implemented | October 1984 |
| Sender net debit caps installed | March 1986 |
| Loss-sharing arrangement among all participants implemented; collateral requirements to support each participant's contingent liability | October 1990 |
| New criteria for settling participants adopted | March 1992 |
| New message format adopted | August 1992 |
| Settlement-finality improvements announced, including reduced net debit caps, increased collateral requirements, and modified loss-sharing procedures | July 1995 |

SOURCES: Hook (1994); Richards (1995).

to the Bank of Japan in 1989 (Bank for International Settlements, 1993b, pp. 261-68).

## *Monitoring and Risk Management in Deferred Net Settlement Systems*

The BIS and individual central banks have strongly encouraged the members of many DNS systems to intensify their risk-management efforts in recent years, hence increasing the private-sector costs of using them. In Europe, the central banks of the (then) European Economic Community set down recommendations regarding the minimum common features of domestic payments systems in 1993 (Bank for International Settlements, 1997a, p. 40). In the United States, the Federal Reserve updated its payments-system risk policy for the design and operation of privately operated large-value multilateral netting schemes in 1994 and again in 1997 (Bank for International Settlements, 1997a, p. 40; McConnell, 1997, p. 2).

Many G-10 central banks now distinguish between "secured" DNS systems — essentially, those that meet the Lamfalussy standards — and all other DNS systems (see Table 6). A secured DNS system is one that is capable of settling all net obligations at the end of a clearing cycle, even when the member with the largest net-debit position is unable to settle (Standard 4). Banks may establish a "failsafe" settlement guarantee by posting collateral in advance, lodging capital funds at the clearing house, forming a joint back-up settlement agreement with the members, obtaining a government guarantee, or some combination of these elements (Bank for International Settlements, 1997a, pp. 39-42).

In principle, direct monitoring by banks of other banks is a potentially significant benefit associated with private multilateral net settlement systems. This is because private financial institutions may obtain finer levels of detail, in a more timely fashion, about other market participants than is possible for central banks or other banking supervisors. The financial exposure one bank creates for another in such a system provides a strong incentive for the creditor bank to monitor the debtor bank.

Table 5

Participants, Number, and Value of Transfers on CHIPS

| Year | Year-End Number of Participants | Annual Number of Transfers (millions) | Annual Dollar Value of Transfers (trillions) |
|---|---|---|---|
| 1971 | 15 | 0.8 | 1 |
| 1975 | 63 | 6.0 | 11 |
| 1980 | 100 | 13.2 | 37 |
| 1985 | 142 | 24.9 | 78 |
| 1990 | 131 | 37.3 | 222 |
| 1991 | 126 | 37.6 | 217 |
| 1992 | 122 | 39.1 | 238 |
| 1993 | 121 | 42.2 | 266 |
| 1994 | 115 | 45.6 | 295 |
| 1995 | 111 | 51.0 | 310 |
| 1996 | 104 | 53.4 | 332 |

SOURCE: CHIPS (1997).

Reliance on direct bilateral monitoring by banks in multilateral payments and settlement systems is subject to at least two shortcomings, however. Most importantly, decentralized monitoring in multilateral DNS systems suffers from a fundamental "free-rider problem." Each participating bank realizes that any losses created by a member in excess of its own resources will be shared among all the remaining members in some fashion. Any individual bank's financial exposure to a counterparty in the system is therefore attenuated by the co-insurance feature of the multilateral system; consequently, that bank's incentive to monitor is reduced. Some elements of shared financial responsibility remain even in systems that attempt to allocate residual risks to members in proportion to their dealings with the defaulting participant. Therefore, diffused financial risks in a multilateral payments and settlement system necessarily imply a reduced intensity and quality of monitoring relative to purely bilateral relationships.

An additional shortcoming is that the monitoring efficiency of a net settlement system is likely to be sensitive to the size of the membership. Increasing the number of participating banks increases the monitoring burden on each bank, a situation that may lead to a decreased quality of monitoring. This problem exists independently of the free-rider problem identified above; in fact, it becomes more acute the less the system shares risk among all participants. To see this, consider a multilateral DNS system that provides no risk sharing at all among its surviving members and which "unwinds" (cancels) all transactions involving a defaulting bank. Each member is fully exposed to the losses created by each of its transactions with a failed counterparty, so it must monitor all of them as if no multilateral system existed at all. If the increased monitoring burden results in a lower quality of monitoring, the end result is a greater risk of unanticipated disruption (Bank for International Settlements, 1997a, pp. 39-43). Restricting the membership of any payments or settlement system to encourage better monitoring incentives is likely to run afoul of antitrust regulations, however. This conflict between restricting access in order to preserve monitoring incentives and the need to remain open to new members to promote competition is likely to become more serious as financial markets become more global and interconnected.

Centralized monitoring (i.e., delegation of monitoring responsibilities to a central authority, such as a clearing house) may be a viable option in some cases, but centralization entails difficult issues in its own right. These include the need to "monitor the monitor" and to decide on a formula

Table 6

The Lamfalussy Standards

| Area of Concern | Proposed Standard |
|---|---|
| 1. Legal basis of netting schemes | Netting schemes should have a well-founded legal basis under all relevant jurisdictions. |
| 2. Participants' understanding of financial risks | Netting scheme participants should have a clear understanding of the impact of the particular scheme on each of the financial risks affected by the netting process. |
| 3. Credit- and liquidity-risk management procedures | Multilateral netting systems should have clearly defined procedures for the management of credit risks and liquidity risks that specify the respective responsibilities of the netting provider and the participants. These procedures should also ensure that all parties have both the incentives and the capabilities to manage and contain each of the risks they bear and that limits are placed on the maximum level of credit exposure that can be produced by each participant. |
| 4. Settlement capability | Multilateral netting systems should, at a minimum, be capable of ensuring the timely completion of daily settlements in the event of an inability to settle by the participant with the largest single net-debit position. |
| 5. Admission criteria | Multilateral netting systems should have objective and publicly disclosed criteria for admission that permit fair and open access. |
| 6. Operational reliability | All netting schemes should ensure the operational reliability of technical systems and the availability of back-up facilities capable of completing daily processing requirements. |

SOURCE: Bank for International Settlements (1990, p. 5).

for allocating any losses that cannot be covered by the pool of resources (collateral or equity capital) held at the central institution. The centralized monitor must also guard against exposing members to moral hazard: When freed from the direct scrutiny of other members, they might be more tempted to act in ways that would increase the system's overall risk. In sum, private-sector risk management in net settlement systems is promising but problematic. Participating banks possess some natural advantages over regulators in providing monitoring services, but private monitoring is likely to be costly and imperfect, regardless of how it is done.

## *Financial-Obligation Netting Systems*

Table 7 lists some important netting systems and agreements for securities, derivatives, and foreign exchange. These arrangements are collectively known as financial-obligation netting arrangements (in contrast to payments netting arrangements). The basic mechanics of netting are similar for multilateral payments and obligation netting systems. In particular, each member of the netting arrangement enters trades with counterparties, which are recorded in real time. It then settles its final obligation to the system—either a net credit or a net debit—only at the end of the clearing cycle. Settlement occurs either several times during the day or once at the end of the day.

In addition to providing periodic net settlement of financial obligations, organized derivatives exchanges also require firms to post and maintain margins. That is, members must make available to the clearing house cash or other liquid assets sufficient to cover likely changes in the net value of the firm's positions implied by movements in financial markets (Bank for International Settlements, 1997b, pp. 21-4). Margin management is an important risk-control tool of derivatives exchanges that requires efficient banking operations (so-called "money settlement") to function effectively. In this sense, financial-obligation netting systems can be compared to DVP systems for securities settlement.

Table 7

Private-Sector Financial-Obligation Netting Arrangements

| Netting System or Agreement | Organizers | Description |
|---|---|---|
| Futures and options exchanges (Chicago Board of Trade, Chicago Mercantile Exchange, Chicago Board Options Exchange, London International Financial Futures Exchange, Deutsche Terminboerse, Marché à Terme International de France, etc.) | Member firms | Clearing Corporations are central counterparties for all transactions with end-of-day mark-to-market and daily settlement through a single settlement account across all exchange-traded contracts. |
| Government Securities Clearing Corporation (GSCC) | Member firms | Government securities clearing agency offering automated trade comparison, netting, and risk-management services |
| National Securities Clearing Corporation (NSCC) | Member firms | Clearing agency for U.S. equities, long- and medium-term corporate and municipal bonds, guarantees settlement |
| Model Interbank Foreign Exchange Netting Agreement (IFEMA) | Foreign Exchange Committee (FEC) and the British Bankers Association (BBA) | Master agreement for bilateral close-out netting, netting by novation, or payment netting of foreign-exchange obligations in an over-the-counter (off-exchange) setting |
| International Securities Dealers Association (ISDA) obligation-netting agreements | ISDA | Framework agreements for implementing obligation netting in an over-the-counter setting |
| Foreign Exchange and Options Master Agreement (FEOMA) | FEC and BBA | Master agreement for bilateral close-out netting of over-the-counter options |

SOURCES: Richards (1995, p. 1075); Labrecque (1996, p. 21); Foreign Exchange Committee (1995); Federal Reserve System (1997).

Organized derivatives exchanges use two primary models for carrying out trading activities and settling margins: the central bank model and the private settlement bank model (Bank for International Settlements, 1997b, pp. 12-15). In the central bank model, the derivatives exchange and/or its members hold reserve accounts directly at the central bank; these accounts can be debited and credited in real time to effect cash transfers in support of trading and margining activities. Most continental European G-10 derivatives exchanges follow this model (Bank for International Settlements, 1997b, Annex 2). This money-settlement model for derivatives exchanges is similar to the "Model 2" DVP securities settlement system noted above (gross securities settlement followed by deferred net settlement of payments), except that the roles of the two financial instruments are reversed. That is, in the central bank model of money settlement for derivatives exchanges, the traded financial obligations are settled on a deferred net basis, while cash payments—including margins—are carried out in the national RTGS system. Of course, cash payments to effect margin and open-position adjustments are not carried out in real time on any derivatives exchange; the point is that the central bank model of money settlement can provide continuous marking-to-market in the cash account.

The second type of money-settlement model for derivatives exchanges involves private settlement banks. This approach—which is used in the United States, the United Kingdom, the Netherlands, and Japan (Bank for International Settlements, 1997b, Annex 2)—is comparable to a "Model 3" DVP system in which both financial obligations and funds transfers are settled on a net basis some time after the trades (or margin calls) are issued. Continuous marking-to-market in central bank funds is not feasible in this model unless private settlement banks are prepared to give derivatives exchange members essentially direct access to RTGS systems via deposit accounts. This approach would approximate the indirect access to Fedwire that non-bank securities dealers obtain in the United States via their clearing banks.

## Systemic Risk in Gross and Net Settlement Systems

If settlement lag is the "building block" of risk in the DNS systems, then systemic risk represents the collapse of the edifice. Systemic risk in its narrowest sense refers to the possibility of a chain reaction of settlement failures in an interlinked payments or settlement system. In more general terms, systemic risk encompasses situations in which the credit or liquidity problems for one or more market participants create substantial credit or liquidity problems for participants elsewhere in the financial system (Berger, Hancock, and Marquardt, 1996, p. 706). It is largely the specter of systemic risk that has preoccupied payments-systems experts at G-10 central banks for the last decade or so, generating the veritable cascade of BIS reports mentioned earlier. The most noteworthy of these reports may have been the Lamfalussy Report of 1990. Under these standards, so-called secured DNS systems are characterized by specific risk-management provisions their members must have implemented to reduce systemic risk (Table 6).

Gross settlement systems seek to eliminate systemic risk by inserting "circuit breakers" into payments and settlement chains. The key is that an institution attempting to make a payment or effect a settlement over a gross settlement system is required to post "cash in advance" (or collateral or securities, depending on the type of payments or settlement system).[13] Gross settlement systems do not allow the insolvency of one financial institution to be transmitted to others through the payments system, because settlements are never conditional on a paying institution's solvency.[14]

By way of contrast, DNS systems merely accumulate records of "IOUs"—that is, credit extensions—issued by banks to each other during the business day. These IOUs are netted against each other and settled in cash or by delivery of the relevant securities or foreign currency at the end of the clearing cycle—as long as none of the participants in a net debit position defaults. In case of such a default, the entire set of transactions may be unwound and re-entered after all of the defaulting institution's transactions have been deleted.

Another factor that makes settlement lag a source of risk is that a party due to receive a payment may prematurely consider the payment final. Since the payee may receive some information about the pending payment during the settlement lag, either from the payor directly or from the DNS system, there may be a temptation, or indeed an established local business practice, to take the payment for granted. Clearly, decoupling the payment information from the final settlement increases DNS flexibility and the flexibility of financial institutions that use it, but it also creates the potential for complex scenarios of disruption.[15]

## Legal Status of Netting Arrangements

As noted, the ultimate source of risk in DNS systems is settlement lag, the time that elapses between the inital transmission of a payment request from the sending bank to the DNS system and the final receipt of good funds or securities by the receiving bank (Bank for International Settlements, 1997a, pp. 7-9; Shen, 1997, pp. 48-53). In addition, legal uncertainty surrounding netting agreements in many jurisdictions makes the risk of settlement failure costly. Rather than being exposed to the smaller risk that a valid netting agreement implies, some banks could lose the larger gross amount due from a coun-

[13] Fedwire allows payors to overdraw their reserve accounts without posting specific collateral; for this reason, some have compared it to a DNS system (Kahn and Roberds, 1996, p. 3). From the payee's (and the systemic-risk) perspective, however, Fedwire functions as an RTGS system, since every payment is final when received.

[14] Unfortunately, in a gross settlement system a distressed financial institution's illiquidity can be transmitted to other participants, resulting in a systemic liquidity crisis or gridlock.

[15] Some RTGS systems are also vulnerable to this problem, as noted above. In particular, those that place outgoing but unexecuted payment orders in a queue and allow receiving banks to "look into the queue" may encourage banks to anticipate payments before they become final.

terparty if the netting agreement did not stand up under legal challenge.

The legal status of interbank netting agreements in the United States results from four different bodies of insolvency law: (1) the U.S. bankruptcy code as amended in 1990, (2) the Financial Institutions Reform, Recovery, and Enforcement Act of 1989 (FIRREA), (3) New York State banking legislation (including Article 4A of the Uniform Commercial Code applying to wholesale electronic funds transfers, drafted in 1989), and (4) the Federal Deposit Insurance Corporation Improvement Act of 1991 (FDICIA).[16]

In general in the United States, netting or set-off arrangements are stayed (i.e., not allowed to proceed) in bankruptcy because netting imposes a *de facto* seniority structure where none exists *de jure* (Rochet and Tirole, 1996, p. 837). Similarly, secured creditors are prevented from repossessing their security after a Chapter 11 bankruptcy filing (Sharpe and Nguyen, 1995, p. 275). From this perspective, netting is inconsistent with the overall intent of formal bankruptcy proceedings, which is to satisfy all creditor demands in an orderly and equitable manner according to strict priority rules. However, certain financial contracts are exempted from this general disallowance of netting in bankruptcy because Congress and many state legislatures have accepted the argument that some netting arrangements should be allowed to proceed to avoid triggering systemic failures in the financial system.

The bankruptcy code, FIRREA, and New York State banking legislation (including Article 4A) are similar with respect to netting agreements, including "safe harbors" for swap agreements, securities contracts, commodities contracts, forward contracts, and repurchase agreements (Russo, 1996, p. 98). In addition, Article 4A and the Federal Reserve's Regulation J (governing large-value electronic funds transfers, including Fed-Wire) explicitly permit net settlement of wholesale electronic funds transfers among banks in order to encourage banks to accept payment orders from financially weak sending banks (Patrikis, Bhala, and Fois, 1994, pp. 36-7).

In contrast to the previous case-by-case legal approach to netting, the FDICIA of 1991 essentially permits all netting agreements among financial institutions (including clearing houses) to proceed notwithstanding bankruptcy or insolvency. In other words, netting agreements now have a firm legal foundation in U.S. law with the implication that the *de facto* seniority created by a netting agreement among financial institutions has become *de jure* and enforceable in transactions for which U.S. law prevails.

In general, the legal status of netting agreements in countries outside the United States is uncertain (Bergsten, 1994, pp. 451-52; Padoa-Schioppa, 1994, pp. 30-5; Bureau of National Affairs, 1997, pp. 721-22). The United Nations Commission on International Trade (UNCITRAL) adopted the UNCITRAL Model Law on International Credit Transfers in May 1992, which could have given an impetus to international efforts to solidify the legal standing of netting. The model law was developed under the influence of the drafters of Article 4A of the U.S. Uniform Commercial Code, which gives explicit legal standing to netting of wholesale electronic funds transfers. In the end, however, the UNCITRAL model law did not include any provisions on the applicability of netting agreements. Consequently, there are still gaps in most countries' insolvency laws concerning the enforceability of netting agreements (Bergsten, 1994, p. 452).

In Switzerland, provisional payment orders issued by a bank that is subsequently declared bankrupt are deemed revoked (the "zero-hour rule")—that is, any netting agreement including such a bank must be unwound. This rule makes netting agreements unreliable for the participants (Hess, 1994, p. 334). Zero-hour rules exist in other countries, as well.

In Japan, settlement of net positions in FEYCS, the Foreign Exchange Yen Clearing System, is not explicitly insured by the Bank of Japan. A loss-sharing

[16] This section follows discussions in Russo (1996, pp. 97-100), Cohen and Wiseman (1994, pp. 53-9), and Patrikis, Bhala, and Fois (1994, pp. 36-7).

arrangement is in place, but beyond this, there is uncertainty about the implications for participants of the default of a member (Saito, 1994, pp. 223-24). The Bank of Japan's implicit guarantee of settlement is widely assumed, however.

In the United Kingdom, finality of payment is determined by common law. In the absence of clear precedents in various kinds of netting arrangements, the legal status of the participants in any given agreement is not entirely clear (Beaves, 1994, p. 364).

In France, the wholesale payments netting system, SAGITTAIRE, is based on S.W.I.F.T. (Society for Worldwide Interbank Financial Telecommunication) messages, which are irrevocable from the point of view of the sender once they have been received. However, the Banque de France may revoke some exchanges. The net positions of members are drawn up after the close of the accounting day, then debited or credited on the books of the Banque de France. Transactions do not become final until 10:00 a.m. the following day. Hence, the legal status of participants in SAGITTAIRE in the face of a default of a participant is unclear (Perdrix, 1994, pp. 148-49). Recently, however, changes have been made in the legal system to assure the legal enforceability of bilateral netting agreements (Padoa-Schioppa, 1994, p. 33).

In the European Union as a whole, only four countries (Belgium, Germany, France, and Italy) currently provide legal assurance for the enforceability of bilateral netting, while multilateral netting agreements have no firm legal standing in any E.U. country.[17] Some progress toward recognition of netting agreements for bank supervisory purposes has been achieved recently at the E.U. level. In particular, the so-called "EC Netting Directive" was issued by the European Parliament and the Council of the European Union in March 1996 (Deutsche Bundesbank, 1996, pp. 146-47). This allows national bank supervisors to adjust banks' capital requirements downward on the basis of close-out netting agreements covering over-the-counter derivative instruments if the concerned banks obtain legal opinions stating that the agreements are likely to be legally binding in all relevant jurisdictions. This is, of course, far short of the solid legal basis for netting agreements available in the United States since 1991 and required by a strict interpretation of the Lamfalussy Standards.

## CONCLUSION

The wholesale payments and settlement systems of G-10 countries have undergone significant change in recent years. Recognizing the inherent limitations and vulnerability to disruption of bilateral and multilateral netting arrangements for payments and settlement, private financial institutions and central banks alike have implemented measures to make them safer. Secured net settlement systems pose less threat of systemic disruption to G-10 payments and settlement systems than unsecured systems. Further progress in establishing legal foundations for domestic and cross-border netting arrangements will further solidify their contributions to the global financial system. The largest costs associated with secured net settlement systems today are those of day-to-day risk management incurred by participating banks.

A different approach to strengthening the wholesale payments system is to create and/or improve trade-by-trade (gross) settlement systems for large-value funds transfers and securities settlement. Gross settlement systems can be very effective in reducing and isolating the sources of risk that make netting systems vulnerable. From the point of view of private-sector participants, gross settlement systems virtually eliminate the need to manage counterparty credit risk. However, these systems may impose significant liquidity costs on users, or they may require substantial risk-management measures on the part of central banks, depending on the design of the system.

There are several plausible hypotheses for why the quantitative importance of gross settlement systems remains limited at this

[17] Table 1 in Padoa-Schioppa (1994, p. 32) summarizes the legal standing of various types of netting arrangements in the major European Union nations as of 1994.

point. First, gross settlement systems have become available in most G-10 countries only recently. It takes time for payments and settlement practices to change, although they probably will continue to do so over the next few years, in large part because central banks continue to encourage greater use of gross settlement.

Second, existing net settlement systems are well-established in most countries, and they generally have a disruption-free track record (even if they are or were unsecured). Proponents of gross settlement systems therefore have little actual evidence with which to bolster their claims that net settlement is excessively risky.

Finally, gross settlement systems may have been adopted slowly because of their significant liquidity costs. These costs could be lessened if central banks paid a market rate of interest on reserve balances or pursued monetary policies that ensured price stability and, hence, lower nominal interest rates than would otherwise obtain. Either approach might encourage financial institutions to hold larger clearing balances (i.e., central bank reserves in excess of legal minimums). These balances could serve as the basis for greater participation in RTGS payments systems at little or no opportunity cost. They would also provide ready collateral for intraday securities lending to support gross settlement of securities transactions.

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