The Reform of Wholesale Payment Systems and its Impact on Financial Markets

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I. Introduction

The explosive growth in the volume of transactions in highly liquid national and international money, derivative, and capital markets during the last ten years—the so-called commoditization of finance—has produced a corresponding increase in flows of gross domestic and international payments. These flows are facilitated by an interlocking network of national and international wholesale payment systems that are at the core of the world’s major financial systems. It is widely recognized that a disturbance in one of these payment systems—an operational mishap, the failure of a major counterparty, a liquidity problem in one of the money markets—could have serious consequences for global trade and finance.

The principal feature of payment systems that is responsible for the transmission of disturbances is the ubiquitous presence of unsecured and sometimes uncontrolled credit in net (deferred) settlement systems and in gross settlement systems, where central banks guarantee the finality of outgoing payments. Because financial institutions make intrasettlement-period payments in anticipation of incoming payments, the failure of a major institution to fulfill its obligation at the time of settlement can have a domino effect: banks that were counting on the institution’s payments to cover their outgoing payments may be unable to meet their own obligations. Thus, in a net settlement system, a single default, by triggering a series of defaults, could lead to payment gridlock. In a gross settlement system, where the finality of outgoing payments is guaranteed, a different concern arises—namely, that the central bank runs the risk
of significant intraday-credit expansion when it must cover payments. In the United States, where payment traffic goes through a central bank in a real-time, gross settlement system, intraday credit has recently averaged nearly $200 billion.

The major industrialized countries have begun implementing various policy reforms to reduce payment-related credit in their financial systems. For instance, some countries have placed limits on the extent of intraday overdrafts on payment systems; others have required that cash be obtained in advance for payments or that credit extended by clearinghouses be secured. In the United States, the Federal Reserve has begun charging for the extensive overdrafts on its wholesale payment system. In Europe, the movement toward a single market and a single currency has spurred a transition to real-time, gross-settlement payment systems that permit only collateralized overdrafts at major central banks. The Clearing House Interbank Payment Systems (CHIPS), the major international net-settlement payment systems for foreign exchange transactions, has imposed caps on intraday debit positions, as well as strengthened intraday payments finality through both a reserve fund and extensive risk-sharing arrangements among its members. In addition, all the national wholesale-payment systems have begun to address the settlement risk that arises in international transactions because the systems' operating hours do not overlap. To reduce the so-called Herstatt risk, they are extending these hours.

These reforms are a positive development, but they will come at a cost. By making intraday credit more expensive, the reforms are likely to reduce the volume of transactions in instruments that are responsible for much of intraday credit—principally, transactions in government securities and foreign exchange. As a consequence, liquidity in these markets is expected to be reduced at times. For example, the full implementation of the ongoing reforms is expected to raise yields on short-dated government securities, as well as increase spreads in foreign exchange markets. But these consequences may well be an appropriate price to pay for the resulting reduction in the risk of a debilitating payments disturbance.

Payment system reforms raise two other issues. First, efforts to reduce daylight credit in central banks' wholesale payment systems may only shift such credit into private netting systems. The reason is that such systems may offer a low-cost alternative to real-time, gross settlement systems, where the cost of daylight credit has been increased through collateralized overdrafts or interest charges on overdrafts. Second, the evolution of two types of real-time, gross
settlement systems—the proposed European system in which central banks supply collateralized, interest-free overdrafts, and the existing U.S. system in which the Federal Reserve charges interest on uncollateralized overdrafts—may encourage the redenomination of financial transactions into U.S. dollars. The reason is that the proposed European system could be more expensive for users than the existing U.S. system, making wholesale payments cheaper to execute and settle in dollars than in other currencies.

Reforms in the technically demanding and unglamorous area of payment systems have been implemented without the fanfare that has accompanied efforts to implement a value-at-risk-based regulatory capital structure for the trading activities of global banks. They are, nevertheless, crucially important and should be regarded as a key component of ongoing efforts to create sound and efficient financial systems. By strengthening payment systems in such a way as to reduce the possibility that payment problems arising in one institution might affect the wholesale payment system and undermine the soundness of other institutions, central banks have increased their degrees of freedom. Indeed, they may soon be able to strengthen market discipline by letting financial institutions fail, perhaps even those that are currently perceived as too big to fail, without threatening the stability of the entire financial system.

Sections II and III of this paper review the nature and the objectives of ongoing and planned payment system reforms in the United States, and the major European Union countries. Section IV discusses the impact of these reforms on the financial system, with particular emphasis on the implication for the availability and cost of intraday liquidity in financial markets. Section V examines the impact of the ongoing shift toward real-time, gross settlement payment systems—the preferred type of system for wholesale payments—on liquidity, the relationship among yields of securities of varying liquidity, bid-ask spreads, and payments conventions in securities markets. The concluding section identifies some unresolved issues.
II. Wholesale Payment System Policy

A bank’s exposure to settlement risk on end-of-day settlement systems is eliminated once it receives payment in central bank funds. Hence, risk can be curtailed by reducing the size of a bank’s exposure or by speeding up the settlement process. The size of a bank’s exposure can be reduced by creating net sender caps and loss-sharing agreements in legally certain netting systems. The settlement process can be accelerated through more frequent settlements during the day or, at the extreme, by immediate settlement of each payment—that is, real-time gross settlement.

It is useful, therefore, to classify payment systems according to the length of the time lag between initiation of a payment and its settlement by the delivery of central bank funds.

Wholesale payment systems can be divided into two types: net-periodic settlement systems and real-time, gross settlement systems. Each is associated with particular risk control measures.

Net-Periodic Settlement

In net-periodic settlement systems, participants send payment instructions to each other over a given period of time. These instructions are settled only at the end of the period on a net basis. As there is no guarantee of their completion until settlement, payments become final only after settlement. Settlement typically is not achieved before the end of the day, although earlier intraday finalization may be achieved through more frequent settlement.
Large-value netting schemes usually employ a multilateral netting procedure, in which the net amount of a bank vis-à-vis the clearing group as a whole is calculated. Netting significantly reduces the need for good funds, because transactors need only have a sufficient volume of the settlement medium—reserve balances at the central bank—to cover net amounts at the end of a settlement cycle. But netting arrangements expose the participants to credit risks as they extend large volumes of payment-related intraday credit to each other. This credit is the lubricant of the financial system; it represents the willingness of participants to accept payment messages, and to send payment messages, on the assumption that the sender will cover any net debit obligations at settlement. The settlement of payments, by the delivery of reserves at periodic (usually daily) intervals, is therefore a key test of the solvency and liquidity of the participants.

The most serious risk in netting systems is the risk of a systemic interruption of wholesale payment flows—that is, the risk that the failure to settle by one possibly insolvent participant will lead to the settlement failures of other solvent participants due to unexpected liquidity shortfalls. Recognizing the systemic risk inherent in netting schemes, the central banks of the G-10 countries have formulated minimum standards for netting schemes. These Lamfalussy standards stress the legal basis of netting. If netting appears not to be legally enforceable in the relevant jurisdictions, a counterparty’s credit exposure may turn out to be the sum of the gross exposures. Multilateral netting schemes should include adequate procedures for the management of credit and liquidity risks. One way to contain such risks is to set limits or caps on the size of each participant’s net debit position, thereby reducing the possibility and extent of settlement failures. In addition, multilateral netting schemes should have backup arrangements to complete settlement when a large participant does not meet its payment obligation. Under such arrangements, non-defaulting participants have to cover the shortfall at settlement according to a loss-sharing rule. To deal effectively with liquidity problems, loss-sharing rules are often backed by collateral that is posted at the clearing house.

Real-Time Gross Settlement

In real-time, gross settlement (RTGS) systems, each payment is immediately settled on a gross basis. Since central bank liabilities (good funds) are the settlement medium in all major wholesale
payment systems, real-time gross settlement occurs on the books of central banks. The direct finality of gross settlement prevents settlement failures, with their potential systemic consequences. In some RTGS systems, the central bank, in addition to acting as the settlement agent, grants daylight overdrafts to the participating banks by guaranteeing all outgoing payment instructions, thereby preserving the liquidity and the processing efficiency of net settlement systems. Participants can make payments throughout the day and only have to square their position or erase their overdraft at the end of the day.

In the absence of collateral for such daylight overdrafts, however, the central bank assumes credit risk until the overdrafts are eliminated at the end of the day. Collateral requirements, or even the more stringent prohibition of overdrafts, minimize credit risk within the payment system, but they also may significantly reduce the liquidity of the system. If good funds or acceptable collateral are not available, the settlement of payments could be rejected or would at least be delayed until cover is obtained. Settlement holdups may reduce both the volume of transactions in money markets and liquidity in all major securities markets. Indeed, in an extreme case, they eventually could lead to a gridlock of the system.

In recent years, electronic book-entry systems have contributed to a swift settlement of securities trades and, consequently, have reduced the lag between transactions and final settlements. In these systems, no physical movement of securities occurs; instead, securities are held at securities depositories, where electronic book-entry transfers are made. Central banks usually operate electronic book-entry systems for government securities in tandem with payment systems.

Some countries have a separate circuit for the settlement of the domestic counterpart of foreign exchange transactions; other countries route such transactions through their main domestic large-value payment system (see Tables 1 and 2, following). Foreign banks generally seek direct access (through branches or subsidiaries) to a country's payment system for the settlement of foreign exchange transactions. If the central bank grants credit on the domestic payment system, it may create a separate circuit for such transactions if it does not wish to grant credit to foreign banks that are not directly or indirectly under its supervision.
<table>
<thead>
<tr>
<th>Country</th>
<th>Discrete-Time Settlement Systems</th>
<th>Continuous-Time Gross Settlement Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>End-of-day</td>
<td>Multiple Queuing No Queuing</td>
</tr>
<tr>
<td>France</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paris Clearing House SAGITTAIRE</td>
<td>1994</td>
<td></td>
</tr>
<tr>
<td>TBF (planned)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNIP (planned)</td>
<td>1996</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAF</td>
<td>1990</td>
<td>1995</td>
</tr>
<tr>
<td>EIL-ZV</td>
<td>1988</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIPPS</td>
<td>1989</td>
<td></td>
</tr>
<tr>
<td>Electronic Memoranda</td>
<td>1989</td>
<td></td>
</tr>
<tr>
<td>EISSO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zengin</td>
<td>1973</td>
<td></td>
</tr>
<tr>
<td>FEYCS</td>
<td>1980</td>
<td></td>
</tr>
<tr>
<td>BOU-NET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switzerland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIC</td>
<td>1987</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Town Clearing*</td>
<td>1946</td>
<td></td>
</tr>
<tr>
<td>CHAPS</td>
<td>1984</td>
<td>1995/6</td>
</tr>
<tr>
<td>United States</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fedwire</td>
<td></td>
<td>1918</td>
</tr>
<tr>
<td>CHIPS</td>
<td>1971</td>
<td></td>
</tr>
</tbody>
</table>

* Town Clearing ceased operation in February 1995.

Note: France (SAGITTAIRE), Germany (EAF), Italy (SIPPS), Japan (FEYCS), and the United States (CHIPS) have a separate system for transfers related to foreign exchange transactions. Switzerland (SIC) and the United Kingdom (CHAPS) settle foreign exchange transfers together with domestic fund transfers in their main system.

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<td>73.1</td>
<td>84.1</td>
<td>85.1</td>
<td>97.0</td>
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<td>8.7</td>
<td>14.3</td>
<td>26.0</td>
<td>31.1</td>
<td>44.7</td>
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<td>SAGITTAIRE</td>
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<td>20.9</td>
<td>27.2</td>
<td>26.6</td>
<td>32.1</td>
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<tr>
<td>Germany</td>
<td>17.1</td>
<td>61.9</td>
<td>132.3</td>
<td>212.9</td>
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<tr>
<td>EAF (daily electronic clearing)</td>
<td>10.0</td>
<td>14.1</td>
<td>20.7</td>
<td>26.0</td>
<td>34.9</td>
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<tr>
<td>Daily (local clearing)</td>
<td>15.3</td>
<td>15.0</td>
<td>20.8</td>
<td>19.6</td>
<td>21.6</td>
</tr>
<tr>
<td>EIL-ZV (integrity credit transfer system)</td>
<td>10.0</td>
<td>14.1</td>
<td>20.7</td>
<td>26.0</td>
<td>34.9</td>
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<tr>
<td>Local credit transfer system</td>
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<td>15.0</td>
<td>20.8</td>
<td>19.6</td>
<td>21.6</td>
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<td>17.2</td>
<td>20.4</td>
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<td>SIPS</td>
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<td>4.3</td>
<td>5.5</td>
<td>5.3</td>
<td>9.3</td>
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<tr>
<td>Electronic Memoranda</td>
<td>4.0</td>
<td>4.3</td>
<td>5.5</td>
<td>5.3</td>
<td>9.3</td>
</tr>
<tr>
<td>Japan</td>
<td>124.6</td>
<td>129.4</td>
<td>132.4</td>
<td>120.0</td>
<td>112.6</td>
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<tr>
<td>Bill and cheque clearing systems</td>
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<td>73.4</td>
<td>87.5</td>
<td>64.8</td>
<td>95.1</td>
</tr>
<tr>
<td>Zengin</td>
<td>29.9</td>
<td>46.3</td>
<td>51.6</td>
<td>52.8</td>
<td>54.5</td>
</tr>
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<td>FEYCS</td>
<td>117.2</td>
<td>147.0</td>
<td>200.4</td>
<td>196.0</td>
<td>196.1</td>
</tr>
<tr>
<td>BOJ-NET</td>
<td>662.8</td>
<td>858.8</td>
<td>1,017.9</td>
<td>1,009.8</td>
<td>1,133.8</td>
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<tr>
<td>Switzerland</td>
<td>69.0</td>
<td>73.4</td>
<td>87.5</td>
<td>64.8</td>
<td>95.1</td>
</tr>
<tr>
<td>SIC</td>
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<td>73.4</td>
<td>87.5</td>
<td>64.8</td>
<td>95.1</td>
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<td>United Kingdom</td>
<td>54.3</td>
<td>44.3</td>
<td>34.1</td>
<td>15.8</td>
<td>9.8</td>
</tr>
<tr>
<td>Clearing &amp; Centrally Managed System</td>
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<td>96.5</td>
<td>134.9</td>
<td>134.7</td>
<td>147.9</td>
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<tr>
<td>CSD</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30.8</td>
<td>48.6</td>
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<tr>
<td>CMO</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>11.7</td>
<td>14.5</td>
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<tr>
<td>United States</td>
<td>640.0</td>
<td>730.4</td>
<td>796.4</td>
<td>786.1</td>
<td>796.8</td>
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<td>Fedwire (funds)</td>
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<td>328.8</td>
<td>393.6</td>
<td>465.2</td>
<td>558.8</td>
</tr>
<tr>
<td>Fedwire (securities)</td>
<td>651.6</td>
<td>730.8</td>
<td>866.4</td>
<td>866.9</td>
<td>963.2</td>
</tr>
</tbody>
</table>

* *This system also handles payments between banks and the Banca d'Italia or the Treasury, which are settled across centralized accounts in eves at the Banca d'Italia.*  
Prevalence of Payment Approaches

Discrete-time payment systems with end-of-day settlement have dominated in most of the major industrialized countries (see Table 1, page 8). In 1992, more daily payment flows went through these systems than through other payment systems in all but two of seven major industrialized countries (see Table 2, page 9). The exceptions were the United States, where a little more than half of fund transfers were settled on a net basis, and Switzerland, where all large-value payments were and continue to be settled on an RTGS basis. In Japan, a majority of payments have been settled on a net basis. In France and the United Kingdom, all payments have been settled at the end of the day since 1984. Although Italy and Germany introduced RTGS systems in 1989 and 1990, respectively, most of their payment volumes were still settled on a net end-of-day basis in 1992.

While discrete-time payment systems with end-of-day settlement have dominated in all but two of the industrialized countries, paper-based payment systems have been replaced, for the most part, by electronic payment systems. These systems make real-time monitoring—a prerequisite for risk management—feasible. In the United States, wholesale payment systems have operated on an electronic rather than paper basis since the 1970s. In Europe, the shift toward electronic wholesale payments started only in the 1980s and 1990s. In Japan, electronic fund transfers began in 1973 but did not become general until the late 1980s.

Advances in domestic payment systems are frequently accompanied by efforts to improve settlement in money markets. By adopting electronic book-entry systems for most government and short-term money market securities, most industrial countries have reduced the cost of trading in these securities. These countries realize that electronic book-entry systems are crucial for establishing a flexible and cost-effective means of pledging collateral in the newly planned RTGS systems.

Queuing Facilities

Some RTGS systems that proscribe overdrafts now employ, or are planning to add, queuing facilities, which relieve the pressure on intraday liquidity by synchronizing incoming and outgoing payments at a central level. If a sending bank lacks good funds to settle a payment message, the message enters a queue to be processed when
sufficient funds have been delivered on incoming payment messages. Two important issues arise in the design of queuing mechanisms: access to information on queued payments, and processing sequence. The first issue is whether receiving banks have access to information on pending incoming payments. If receiving banks have such access, queuing mechanisms can generate the same type of risks as discrete-time, net settlement systems. To the extent that the receiving bank acts on this information by making these uncashed funds available to its customers, there exists credit risk until the queued payments are settled. Even when banks do not forward unsettled payments to their customers, the risk of a liquidity shortfall exists, insofar as banks rely on queued payments for their liquidity management. Because queuing mechanisms are meant to facilitate such liquidity management, banks are likely to employ information on pending payments for that purpose. A heavy reliance on queuing facilities may generate significant settlement risks and thus undermine the essence of real-time gross settlement. In practice, however, only a small proportion of all payments may be pending in a queue for a short time.

The Swiss RTGS system, SIC, has experienced the dynamics of queuing since it began operating in 1987. In this system, pending payments are not automatically delivered to the receiving bank and may be canceled at any time by the sending bank, which has access to information on queued payments. Credit risk is less of a problem in SIC, because a large part of SIC’s payment volume is related to foreign exchange transactions—in particular, U.S. dollar-Swiss franc transactions. Nevertheless, Swiss banks rely heavily on queued incoming payments as cover for queued outgoing payments, thereby creating a substantial liquidity risk. This risk is easily illustrated: in 1995, on average, only 51 percent of the payment volume was settled by 2:00 P.M., while 95 percent was initiated by that time.

Some banks do not have access to information on queued payments. The Bank of England will deny Clearing House Automated Payment System (CHAPS) settlement banks access to such information to avoid liquidity and credit risks. German banks participating in Germany’s gross settlement system (ELZV) also lack access to such information, but a discussion about continuing the policy is currently under way. The proposed arrangements for information about queuing in France’s TBF also are under discussion. The Banca
d'Italia is proposing to give receiving banks access to information on queued payments as in SIC. ¹¹

The second important issue in the design of queueing mechanisms is the processing sequence. Whilst the Swiss, English, German, French, and Italian RTGS systems will use a first-in, first-out (fifo) rule, they and most other RTGS systems have or will have, in addition, a priority code for certain time-critical payments, such as the results from domestic retail clearing or delivery-versus-payment (DVP) transactions. SIC introduced a priority code in July 1994 and kept the fifo rule for a given priority level. The introduction of this priority code was crucial to the establishment of a real-time DVP link between SIC and SFCOM, the new electronic book-entry system for the transfer of Swiss securities. Even with such a priority mechanism, however, securities transfers may be unduly delayed if the buyer’s reserve balance is insufficient for executing the payment leg.

Germany, France, and Italy also employ, or plan to employ, a combination of the priority and fifo rules. The United Kingdom is the only country that will not incorporate the priority option. The Bank of England will operate a processing or optimization mechanism to allow simultaneous settlement of queued payments on a net basis, but prime responsibility for managing any queued payments will rest with the individual banks.¹²

**Settlement of Foreign Exchange Transactions**

Foreign exchange (forex) markets are the deepest, the most liquid, indeed the only truly global, markets. They are decentralized, and a significant part of trading in them is carried out between dealers.

The settlement of forex transactions raises significant systemic risk concerns, owing to the relatively large daily volumes involved. In April 1995, actual turnover in forex markets mounted to nearly $1.23 trillion per business day (see Table 3, page 13). As the two legs of a forex transaction need to be settled in the national payment systems of the two respective currencies, payment flows are twice this figure.

The volume of payment transactions related to forex trade is substantial (see Table 4, page 14). In the case of the United States, for example, international transactions amount to more than a third of total transactions.¹³ The surge in forex trading over the last decade is thus one of the major factors behind increasing payment volumes. Some payment systems, such as CHIPS in the United States, EAF in Germany, SAGITTAIRE in France, and the Foreign Exchange Yen
## Table 3. Average Daily Gross Foreign Exchange Turnover, April 1992 and April 1995

<table>
<thead>
<tr>
<th></th>
<th>April 1992</th>
<th>April 1995</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily turnover</td>
<td>Percent of total</td>
</tr>
<tr>
<td>U.S. dollar</td>
<td>672.4</td>
<td>82</td>
</tr>
<tr>
<td>Japanese yen</td>
<td>148.6</td>
<td>23</td>
</tr>
<tr>
<td>Deutsche mark</td>
<td>328.0</td>
<td>40</td>
</tr>
<tr>
<td>French franc</td>
<td>32.6</td>
<td>4</td>
</tr>
<tr>
<td>Italian lira</td>
<td>14.8</td>
<td>2</td>
</tr>
<tr>
<td>U.K. Pound sterling</td>
<td>114.8</td>
<td>14</td>
</tr>
<tr>
<td>Swiss franc</td>
<td>73.8</td>
<td>9</td>
</tr>
<tr>
<td>Other currencies</td>
<td>250.6</td>
<td>38</td>
</tr>
<tr>
<td>All currencies</td>
<td>1,640.0</td>
<td>200</td>
</tr>
</tbody>
</table>

* The actual turnover was $820 billion, as two currencies are involved in each transaction.
* The actual turnover was $1,230 billion, as two currencies are involved in each transaction.


Clearing System (FEYCS) in Japan, are mainly concerned with the settlement of forex transactions.

The main risk in the settlement of forex transactions is that one party might settle its part, while the other party fails to do so. This is called Herstatt risk, after Bankhaus Herstatt, a small German bank that went into liquidation in 1974, at a time when the European leg of its forex trades was irrevocably settled before the dollar leg was settled through CHIPS. Herstatt or cross-currency settlement risk results from major payment systems’ non-overlapping operating hours, a consequence of the different time zones in which the major central banks are located. Hence the simultaneous settlement of the two currency legs is delayed.

Private-sector settlement practices can contribute to Herstatt risk. A recent survey of industry practices found that back-office procedures had not kept pace with the rapid changes in the market. 5 Payment instructions often are sent by banks to overseas correspondents one or two days before actual settlement. Even if the originating bank discovers, before settlement, that its counterparty has failed, it cannot always stop its own payment from being made. Similarly, banks often do not reconcile the expected receipts with the settlement sent by their correspondents until the day after settlement or later. Thus banks can continue to trade with a
Table 4. Break-down of Daily Payment Flows
(in billions of U.S. dollars)

<table>
<thead>
<tr>
<th>Country</th>
<th>1992</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily payment flow</td>
<td>291.5</td>
<td>100.0</td>
</tr>
<tr>
<td>International transactions</td>
<td>44.1</td>
<td>23.2</td>
</tr>
<tr>
<td>Securites transactions</td>
<td>22.7</td>
<td>13.7</td>
</tr>
<tr>
<td>Treasury bills</td>
<td>9.0</td>
<td>5.5</td>
</tr>
<tr>
<td>Other debt securities &lt; 7 yrs</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Government bonds</td>
<td>8.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Other bonds and equities</td>
<td>11.0</td>
<td>5.5</td>
</tr>
<tr>
<td>Other transactions</td>
<td>120.1</td>
<td>41.1</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily payment flow</td>
<td>420.4</td>
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</tr>
<tr>
<td>International transactions</td>
<td>200.5</td>
<td>48.8</td>
</tr>
<tr>
<td>Securities transactions</td>
<td>12.0</td>
<td>2.9</td>
</tr>
<tr>
<td>Other transactions</td>
<td>204.9</td>
<td>48.4</td>
</tr>
<tr>
<td>Italy</td>
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<td></td>
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<tr>
<td>Daily payment flow</td>
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<td>100.0</td>
</tr>
<tr>
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<td>Bonds and equities</td>
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<td>0.4</td>
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<tr>
<td>Other transactions</td>
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<td>44.7</td>
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<tr>
<td>Japan</td>
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<tr>
<td>Daily payment flow</td>
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<tr>
<td>International transactions</td>
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<tr>
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<td>7.5</td>
</tr>
<tr>
<td>Treasury bills</td>
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<td>2.2</td>
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<tr>
<td>Financing bills</td>
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<td>Japanese Government bonds</td>
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<td>Agency and corpora bonds</td>
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</tr>
<tr>
<td>Other transactions</td>
<td>8.4</td>
<td>1.6</td>
</tr>
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</table>

counterparty for one or more days before finding out that the counterparty did not deliver on its past obligations.

The Nol Report explores different institutional approaches to reduce Herstatt risk. One approach is extending the operating hours of domestic payment systems. The Bank of Japan recently extended the operating hours for the Bank of Japan Financial Network System (BOJ-NET) by two hours, while the Federal Reserve has announced that, starting in late 1997, it will expand Fedwire’s operating hours by eight hours. As a result of these changes, the Japanese and U.S. settlement periods will overlap by two and a half hours. Moreover, the new Fedwire hours mean that Fedwire will be open throughout the European business day.

But the extension of operating hours is not, in itself, sufficient
to eliminate Herstatt risk. Linkages between real-time, gross settlement systems have to be established to achieve simultaneous settlement or payment-versus-payment (PVP) settlement. Such linkages pose their own problems. First, access to cash via the central bank, the money market, or both must overlap to obtain PVP settlement, because banks need a mechanism for raising additional funds when they are confronted with unexpectedly large payment outflows. Second, liquidity shocks could easily be

<table>
<thead>
<tr>
<th>Country</th>
<th>1992</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily payment</td>
<td>29.7</td>
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<tr>
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<tr>
<td>Other transactions</td>
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</tr>
<tr>
<td>Equities</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>United States*</td>
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<td>Daily payment</td>
<td>2,308.8</td>
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</tr>
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<td>Foreign transactions</td>
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<tr>
<td>Other securities</td>
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<td></td>
</tr>
<tr>
<td>Other</td>
<td>270.7</td>
<td></td>
</tr>
<tr>
<td>Commercial and miscellaneous</td>
<td>270.7</td>
<td></td>
</tr>
</tbody>
</table>

* These figures do not include repurchase agreements involving Treasury bills.

1 This is an estimated figure. Approximately 97 percent of the credit transfers in EAF is presented in S.W.I.F.T. format, which is used for foreign exchange and cross-border transactions.

2 This is an estimated figure. SIC payment flows on a U.S. public holiday are approximately 10 percent of the payment flows on a normal day (BIS, 1993b). On days that the U.S. markets are closed, other currencies also are not very actively traded against the Swiss franc.

3 The breakdown of the daily payment flow in 1992 is based on 1986 data, assuming an unchanged composition of payment flows. In 1969, the Federal Reserve concluded a detailed survey dealing with the nature and composition of payments.

Note: The breakdown of payment flows in international, securities, and other transactions should be interpreted with caution, because those figures are not available in some countries. The value of securities transactions, for example, represents in some cases only transactions settled via the major securities settlement systems, thus ignoring transactions settled via other circuits. Any cross-border comparisons should therefore be made with great care.

transmitted across borders when domestic RTGS systems are linked. Settlement delays resulting from a liquidity shock in one system could, for example, cause settlement delays in other systems that are linked to it.\textsuperscript{16}

Another option for reducing Herstatt risk is to employ multicurrency netting schemes, such as the European Commission Host Organisation (ECHO, which began operating in London in 1995) and Multinet (which is expected to begin operating in Chicago in 1996). According to some estimates, multilateral netting can reduce settlement volume by 75 percent on average,\textsuperscript{17} generating substantial savings in settlement costs. But the settlement of net amounts is still subject to Herstatt risk. To comply with the Lamfalussy standards for multilateral netting schemes, participants are obliged to arrange firm financing for the largest net payment owed to the clearing house. This payment can be considerable, even after netting. According to some estimates, the largest single payment can amount to approximately \$1.5\ billion for ECHO and Multinet.\textsuperscript{18}

Several options for covering this largest single payment have been examined. The first option is to rely on credit lines provided by the participants. If a settlement failure occurs, then the clearing house can call upon these credit lines. But central banks have argued that such credit lines do not constitute firm financing. Moreover, this solution relies on borrowing to cover a settlement shortfall. Because markets may be disrupted, as a result of the failure of a large participant to settle, or may already be closed, such borrowing may not be feasible at short notice.

A second option is to collateralize the largest possible net payment obligation in full in advance. For example, ECHO maintains U.S. Treasury securities with some New York money center banks that could be used as collateral for emergency lending to cover a settlement shortfall. (Even if the shortfall is in a currency other than the U.S. dollar, the proceeds could be converted to that currency via a foreign exchange swap.) But the extra cost of maintaining such a large pool of collateral is considerable.

A third option is to arrange a simultaneous exchange of currencies via PVP settlement. If a participant fails to deliver one of the currencies by a set time, the other currencies could be withheld until the first payment is made. The withheld currencies could be used as collateral to support any borrowing by the
clearing house to cover its payment obligations in the currency in which the settlement failure occurred.

**Delivery versus Payment for Securities Transactions**

Real-time gross settlement without uncovered daylight overdrafts reduces the settlement risk associated with domestic payments and with securities and international transactions, which constitute a sizeable portion of large-value funds transfers (see Table 4, page 14). The main risk in securities, as in foreign exchange transactions, is that one party might settle its obligations, while the other party fails to do so. To eliminate this principal risk for the settlement of securities transactions, the Group of Thirty has recommended DVP transactions to ensure that securities are transferred from the seller to the buyer if and only if funds are transferred from the buyer to the seller.13

A link between an RTGS system and a real-time, book-entry, securities settlement system enables parties to make DVP transactions on a trade-by-trade basis. Several such links exist, and others are in the works. For example, the U.S. Fedwire book-entry system for the transfer of U.S. government securities allows for the immediate and simultaneous transfer of securities and central bank money. In 1994, BOJ- NET linked fund transfer and book-entry systems, allowing DVP transactions in Japanese government bonds. In 1995, Switzerland linked its SECOM system with SIC to provide for DVP transactions on a trade-by-trade basis. Once the conversion of CHAPS to a RTGS system is completed, the United Kingdom may develop a mechanism to provide real-time DVP transactions for the settlement of gilts in the Central Gilt Office (CGO) and money market instruments in the Central Moneymarkets Office (CMO). At present, transfers of securities in these systems take place in real time against final settlement of payments across accounts at the Bank of England at the end of the day.14 Although France, Germany, and Italy also have electronic book-entry systems for securities settlement, securities are not yet settled on a real-time DVP basis.15 Nevertheless, once the RTGS systems become fully operational and are more actively used, further measures to strengthen DVP linkages in these countries can be expected.
III. Payment System Reforms in the United States and Major European Union Countries

The payments-related reform efforts that are under way in the major industrial countries are motivated by:

- Greater awareness of the systemic risk inherent in discrete-time, net settlement arrangements, and, in particular, the recognition that a central bank would be obliged to intervene to avoid systemic disruption should a serious failure occur, and
- The growing credit-risk exposure of central banks in real-time, gross settlement systems. The main objective of these reforms is to improve the safety features of domestic wholesale payment systems and to force banks to internalize the cost of third-party risk.22

Controlling Payment System Risk in the United States

In the United States, controlling risk in the RTGS system has taken two principal forms: placing caps on the amount of uncollateralized overdrafts and pricing overdrafts.23 In March 1986, the Federal Reserve, recognizing the risks that it was bearing in allowing overdrafts on the Fedwire system, required banks to establish caps for combined Fedwire overdrafts and net debit positions on CHIPS. The caps were stated as multiples of bank capital; and in succeeding years, the permissible multiples by which overdrafts are allowed to exceed
capital have been reduced. With the advent of a separate risk-control system on CHIPS, including net debit caps, the caps imposed by the Federal Reserve were made applicable to Fedwire alone in January 1991. Currently, these caps are defined at varying multiples of capital across six categories of financial institutions, ranging from those with a cap of zero to those with a high level of overdrafts—2.25 times capital for overdrafts on any given day and 1.5 times capital for the average maximum overdraft during a two-week period. To control risk on CHIPS, the New York Clearing House imposed a system of bilateral credit limits in 1984, net debit caps in 1986, and a loss-sharing arrangement backed up by collateralization in 1990. The loss-sharing arrangement specifies that each surviving bank shares in losses proportional to its share in the sum of bilateral caps that were granted to the bank that fails to settle. The loss sharing—which covers only the failure of the bank with the largest permissible overdraft—partly internalizes the cost of settlement failure. Banks thus have an incentive to monitor the creditworthiness of other banks and to intervene by reducing their bilateral caps.23 But the Federal Reserve, in its role as lender of last resort, may still have to provide liquidity assistance in the case of multiple bank failures in order to prevent a systemic crisis. In 1995, it launched a further risk control program under which a 20 percent reduction in net debit caps will be implemented by January 1997; it also imposed an increase in the minimum amount of collateral.24 The Federal Reserve monitors banks’ overdraft positions on Fedwire on a real-time basis at the end of each minute to assure that the daily cap has not been breached.25 Excessive violation of overdraft caps triggers a regulatory response of varying severity, including a rejection of further payments that generate the overdrafts.26 But thus far caps have not reduced the amount of overdrafts, which rose from a typical daily peak of $60 billion in 1986 to more than $120 billion in 1993. Most of this increase was related to payments generated by securities transactions. Funds-related overdrafts grew from about $40 billion daily in 1986 to about $50 billion daily in 1993, so the imposition of caps coincided with slower growth in this transaction category.

In 1994, the Federal Reserve began a program to impose charges for overdrafts beyond a permissible allowance. The initial charge was ten basis points at an annualized rate on average overdrafts during the day beyond a certain allowance.27 Peak overdrafts immediately fell on average by 40 percent—from nearly $125 billion
to approximately $70 billion. Securities-related overdrafts and funds-related overdrafts also fell by 45 percent and 25 percent, respectively. (A subsequent rise in the fee to fifteen basis points in April 1995 had little marginal impact: average and peak overdrafts in the six months after the change were on the same order of magnitude as those in the same period in 1994.) Thus, the imposition of a fee had a more dramatic impact on overdrafts than that of caps. The reason is that caps tend to be the constraining factor in most financial institutions, which tend to pay very small overdraft fees. For the small number of large financial institutions, fees are the constraining factor: six institutions alone accounted for 90 percent of the reduction in overdrafts, and the ten banks with the largest overdrafts still account for 70 percent of overdrafts.31

Choice for Real-Time Gross Settlement in Europe

The major European Union countries, in the context of discussing the future monetary system in Europe, have declared their strong support for adopting real-time, gross settlement systems for wholesale payments in Europe. Three factors have led to this support. The first factor is the fast-growing volume of payment flows that has resulted in massive intraday credit exposures and, consequently, a surge in settlement risk in the major countries. Although all parties acknowledge that substantial risk reduction can be achieved by decentralized risk controls, such as bilateral and multilateral limits on daylight credit, some European central banks would like to go further by removing interbank payments-related credit from the payment system altogether.32 Other central banks—the Banque de France and the Deutsche Bundesbank, for example—have taken an intermediate position by requiring real-time gross settlement for certain time-critical payments and allowing net settlement for the remaining large-value payments.33 One argument advanced by the Bank of England against net settlement is based on a view of the "inherently uncontrollable" nature of interbank credit in net settlement systems. When a receiving bank accepts a payment, it extends an interbank credit to the sending bank until settlement. Ideally, bilateral caps imposed by the receiving bank to control interbank credit exposure will be based on the creditworthiness of the sending bank. But because those payments that are generated by the sending bank’s customers and that exceed the bilateral cap will be blocked, bilateral caps also will have to take into account the payment traffic between the two banks to avoid significant settlement
In short, a minimum level of interbank credit is required for the smooth running of a net settlement system, and yet there exists a fundamental conflict between prudential and operational needs.

The second factor underlying support for RTGS systems is the somewhat doubtful legal status of netting in some countries. This problem is simplified by the introduction of the single market for banking services. The Second Banking Directive allows for remote access of banks located in one EU country to payment systems in other EU countries. For net settlement with multinational participation to be safe, the insolvency law of every country involved has to be adequate. But whether this is the case is far from clear at present. Although payments settled through gross settlement systems also can be challenged by a liquidator, the legal risk is manageable, as payments from the liquidated bank may be identified and revoked; but other payments that already are settled will not be affected. Thus the whole settlement process will not be undone at once.

The third factor underlying support for RTGS systems is the opportunity that they offer for real-time, DVP transactions and hence for the reduction, if not the elimination, of settlement risk in securities transactions. Most European countries have introduced, or are planning to introduce, real-time, book-entry systems for the transfer of securities in place, but RTGS systems are needed to ensure the real-time transfer of funds.

Although support for RTGS systems is widespread, not all European countries are planning to adopt them. Germany, for example, is implementing measures to reduce risk in its main netting system, EAF. One can argue, however, that the scheduled improvements of EAF (30-minute settlement cycles and collateralization of net debit positions on an ex-post basis) will bring it closer to a fully-collateralized RTGS system, such as the future CHAPS and TBF, than to a netting system with decentralized risk controls, such as CHIPS. Because the membership of EAF is more dispersed than that of CHIPS, German banks are very reluctant to grant bilateral receiver limits—that is, credit lines—to each other and to share losses in case of a settlement failure.

Preparing for Economic and Monetary Union

With the establishment of the single market in 1992 and the prospect of a single currency in 1999, a new dimension has been added to the debate on risk-reduction in European payment systems. In January
1991, the then Committee of EC Central Bank Governors created the Ad Hoc Working Group on EC Payment Systems to discuss "issues of common concern in the field of payment systems." In its latest report, the Working Group examined the implications of the single market and explored the possible linking of payment systems in the third stage of Economic and Monetary Union (EMU). One of the principles laid down in the report reinforced the move toward real-time gross settlement: "As soon as feasible, every member state should have a real-time, gross settlement system into which as many large-value payments as possible should be channeled."

With the start of the second stage of EMU in January 1994, the European Monetary Institute (EMI) took over from the Committee of EC Central Bank Governors. In May 1995, EMI published a blueprint of the new payment system for the single currency. The new system, called TARGET (Trans-European Automated Real-Time Gross Settlement Express Transfer System) will build upon national RTGS systems and provide an interlinking mechanism. Under TARGET, bilateral links between the national central banks (NCBs) will be established. Each prospective member country will have to implement an RTGS system before it can join EMU. Banks will be able to keep their settlement accounts at the NCBs, and the role of the ECB will be limited.

In the early stages of TARGET, EMI proposes that payment system features affecting the implementation of a single monetary policy, such as the provision of liquidity, be harmonized. But no harmonization of queuing procedures in the payment systems of individual countries is planned. The lack of such harmonization may cause problems, because systems with sufficient liquidity and no queuing will send liquid funds in real time, while systems with low liquidity and heavy reliance on queuing will delay outgoing payments. Thus the RTGS systems with queuing may be draining liquidity from other, more liquid systems.

Although collateral will be immobile under TARGET—banks can only pledge collateral for obligations within their payment system—liquidity will freely move across borders. Furthermore, banks will be able to participate in the payment system of more than one country and transmit liquidity between their accounts. The TARGET blueprint stresses that a well-functioning payment system is needed as a channel for arbitrage flows to establish a single monetary policy throughout EMU. Payment transfers that are routed via the interlinking of national systems will be exclusively denominated in the European currency. To create an open system, non-EMU
central banks will have the option to link their RTGS systems to TARGET, provided that they convert payments from their national currency into the European currency before the payments are transmitted.

**Shifting toward Real-Time Gross Settlement**

It has become generally accepted that systemic risk in wholesale payment systems can be better controlled in real-time, gross settlement systems than in net settlement systems. Once the decision to move toward an RTGS system has been made, central banks must set the size of permissible overdrafts, the rate of charges for overdrafts, and the type of collateralization required.

**United Kingdom.** In concert with the Bank of England, commercial banks in the United Kingdom have adopted an evolutionary approach to convert CHAPS to an RTGS system in 1995-96. As a short-term measure, CHAPS banks have implemented bilateral receiver caps to contain intraday credit exposures. Since March 1993, U.K. banks have been experimenting with multilateral or net sender limits. Their objective was to reduce voluntarily net sender limits to 25 percent of the sum of the bilateral limits by September 1994, with a further reduction foreseen after that date. Although these net sender limits are not binding, their use enables banks to assess how much collateral will be needed in the new RTGS system. Thus far, the introduction of bilateral and multilateral limits has not caused any major problems. CHAPS banks have responded to these limits by rescheduling the input of payment messages to reduce imbalances between incoming and outgoing payments. But because most payments are originated by customers, the ability of banks to reschedule payment flows is constrained to some extent.

**France.** France plans to switch from paper-based netting procedures to an electronic RTGS system, TBF. The transition will involve several challenges. To date, French banks have been unaware of how their net debit positions vary during the day, because real-time monitoring is not possible in paper-based payment systems. In addition, French banks have had little experience with optimizing their payment flows to reduce the size of their maximum net debit positions during the day—that is, peak overdrafts—which will have to be collateralized in TBF. As French banks are thus faced with both the cost of building gateways to the new electronic payment system and the opportunity cost of pledging collateral, they have
chosen to develop a private electronic netting system (SNP) that will meet the Lamfalussy standards to save on collateral holdings. This system will run in parallel to TBF, which the Banque de France will implement in 1996.

Germany. Germany upgraded its gross settlement system (EIL-ZV) in 1988, but only a relatively small amount of large-value payments are settled across the system. The Bundesbank, in consultation with the German banking sector, has decided to reduce risk in its electronic net settlement system (EAF), rather than to encourage a shift from net settlement to real-time gross settlement. The main rationale for preserving and improving the netting system for large-value payments is to reduce the need for reserves and to increase the system's flexibility to cope with the payment volumes to be processed.

Two improvements in risk management for EAF are proposed. The first improvement involves the Bundesbank's increasing practice of requiring banks to pledge collateral, which (together with bank reserve balances) is used as cover for net debit positions. Since March 1994, the Bundesbank has based the collateral requirement on the highest net debit position of the preceding month, rather than on actual net debit positions. The second improvement is to speed up the settlement process. To this end, as many payments as possible will be bilaterally netted and subsequently settled in 20-minute cycles. Because incoming and outgoing payments between a pair of banks will not exactly balance, each bank has to set bilateral sender limits on the amount of liquidity that it is prepared to advance to other banks in this bilateral settlement procedure. To provide cover for these bilateral limits, reserve balances, the collateral of the sending bank, or both will be blocked up to an amount equal to the sum of the bilateral limits. Payments not bilaterally settled will remain in a queue for processing in subsequent settlement cycles on a fifo basis. Remaining payments will be netted multilaterally and settled in the usual way at the end of the day. The objective of this new multiple settlement procedure, EAF2, is to obtain early and intraday finality for as many payments as possible. But no penalty or differentiated fee structure will exist to discourage banks from relying on the end-of-day multilateral netting procedure. Therefore, it remains to be seen how much intraday liquidity banks are prepared to preserve for the bilateral settlement cycles in order to achieve early finality.

Italy. As in EIL-ZV, only a relatively small amount of large-value payments is settled across Italy's present RTGS system, BISS. Therefore,
Italy is planning a drastic overhaul of the system to make it more attractive for the participating banks. In a recently published white paper, which has an advisory status, the Banca d'Italia outlines the proposed conversion of BISS to its revised RTGS system, BIREL. While the present cover principle will be maintained, BIREL will incorporate a more flexible supply of intraday liquidity and a queuing mechanism. The Banca d'Italia will grant daylight overdrafts on a collateralized basis and, in the future, may widen the range of securities eligible as collateral. In addition, banks probably will be allowed to make full use of their reserves intraday. In 1994, the “monetary” reserve requirement amounted to 17.5 percent of deposits (see Table 5), of which only 8 percent could be used by banks for payment purposes, while the remaining 9.5 percent was frozen during the day. The current netting systems for large-value payments (SIPS and Electronic Memoranda) will be phased out.

Other European Union Countries. Denmark has processed most of its large-value payments on an RTGS basis since 1981. Denmark’s Nationalbank grants daylight overdrafts without cover to the participating banks up to 100 percent of a bank’s own funds, but it may introduce a collateral requirement for daylight overdrafts. In the Netherlands, the Central Bank System is a mixed system in which “irrevocable payments” are settled in real-time (provided that sufficient cover is available), and revocable payments are settled at the end of the day. The Nederlandsche Bank plans to phase out the revocable payments and thus to convert the system to a fully-fledged real-time, gross settlement system by 1996. Belgium, Ireland, Greece, Portugal, and Spain also have plans to introduce RTGS systems by 1996, but Luxembourg currently has no such plans.

Co-existence of Net and Gross Settlement
An unresolved policy issue is the co-existence of net and gross settlement systems at the national level. Commercial banks favor netting arrangements, because they may make liquidity management less costly. But netting schemes usually achieve final settlement at the end of the business day through gross settlement systems that are operated by central banks.

The United States has much experience with the side-by-side operation of netting and RTGS systems. To avoid distortions that might result from competition between these two systems, the Federal Reserve adopted the above-noted twin-track approach to
controlling payment system risk. And, before charges for daylight overdrafts were introduced on Fedwire, the New York Clearing House imposed multilateral caps and loss-sharing arrangements in CHIPS. Thus far, little or no payment volume has migrated from Fedwire to CHIPS in response to daylight overdraft fees. European central banks have repeatedly expressed their desire to implement RTGS systems, but European commercial banks may still have a preference for net settlement, as netting reduces significantly the need for liquidity. As noted above, French banks are developing a net settlement system, SNP, which should run in tandem with an RTGS system, TBF. Germany decided to strengthen and preserve its netting system, EAF. In Japan, nearly all wholesale payment systems are netting systems. The one exception is BOJ-NET, in which banks can elect to settle on an RTGS basis. They also can choose to settle on a designated time basis at four given times of day, however. In practice, the RTGS mode is used for only one percent of total payments.

Research comparing the costs of net and gross settlement indicates that the cost of extra liquidity holdings in real-time gross settlement could, under certain circumstances, exceed the benefits of the obtained reduction in settlement and systemic risk. According to the proposals for RTGS systems in Europe, banks must collateralize fully any daylight overdrafts to eliminate settlement and systemic risk. Because the opportunity cost of tying up securities as collateral is estimated to be around 25 basis points, the cost of maintaining sufficient collateral could be considerable. The alternative is to preserve and improve existing netting schemes. The expected cost of settlement failures in these schemes is calculated as the probability of bank failure multiplied by the net debit position of the failing bank. The cost of settlement failures is actually moderate, and the aggregate cost of these failures in netting systems appears to be about half the aggregate cost of collateral holdings in RTGS systems. Different scenarios for the resolution of settlement failures would not significantly alter this cost differential. Netting systems are thus the lower-cost alternative.

But how can this finding be reconciled with the European central banks' preference for real-time gross settlement over net settlement? One way to explain this preference is that the banks wish to restrict their role as lenders of last resort in payment systems, thereby strengthening market discipline. The lack of supervisory powers for the prospective European Central Bank suggests that the bank's role as a lender of last resort would be
minimal. The obvious way to reduce the bank's intervention would be to link domestic RTGS systems without daylight credit exposures. If safer and more expensive payment systems then led to less banking regulation and supervision, the balance between netting and real-time gross settlement would be unclear. But the potential benefits arising from a more permissive and less distorting regulatory system could outweigh the extra cost of real-time gross settlement.
IV. Payment Reform and the Availability and Cost of Intraday Liquidity

A common principle underlying the introduction of real-time gross settlement in Europe is that there be no extensions of uncovered daylight credit to the participating banks. These banks must have settlement funds in the form of reserves or collateral at a central bank before they can make payments. Otherwise, settlement delays could occur, any one of which could trigger a series of settlement failures and lead to a gridlock of payment flows, thereby defeating the purpose of introducing real-time gross settlement—namely, the direct finality of payments.

In short, a certain amount of intraday liquidity is crucial for the smooth running of an RTGS system.

Two sources of intraday liquidity are reserves and daylight overdrafts. Banks in France, Germany, Italy, Switzerland, the United Kingdom, the United States, and Japan are, or will be, allowed to use their reserves for settlement purposes during the day (see Table 5). In addition, banks participating in the real-time gross settlement systems of France, Germany, Italy, the United Kingdom, and the United States can get daylight overdrafts. The Federal Reserve has adopted a system of charging for such overdrafts; the European central banks will implement a collateral requirement for them.

The introduction of real-time gross settlement that is based on the cover principle will demand active liquidity management by banks. It also may require a more frequent injection of reserves
### Table 5. Intraday Liquidity in Selected RTGS Systems

<table>
<thead>
<tr>
<th>Country</th>
<th>CB daylight overdrafts</th>
<th>Collateral requirement</th>
<th>Intraday use of reserves</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>yes</td>
<td>full</td>
<td>full*</td>
</tr>
<tr>
<td>Germany</td>
<td>yes</td>
<td>full</td>
<td>full</td>
</tr>
<tr>
<td>Italy</td>
<td>yes</td>
<td>full</td>
<td>full*</td>
</tr>
<tr>
<td>Japan</td>
<td>no</td>
<td>-</td>
<td>full*</td>
</tr>
<tr>
<td>Belgium</td>
<td>no</td>
<td>-</td>
<td>full</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>yes</td>
<td>full</td>
<td>full*</td>
</tr>
<tr>
<td>United States</td>
<td>yes</td>
<td>no*</td>
<td>full</td>
</tr>
</tbody>
</table>

*The amount of required reserves held by the French banks is negligible.

*With the introduction of BIREL, in 1996, the Banque de France is considering allowing banks to make full use of their reserves intraday. At the moment, banks are allowed to use only a part of their reserves for intraday settlement purposes.

*U.K. banks are required to hold a small Cash Reserve Deposit with the Bank of England, which is meant to generate income for the Bank to cover its operating expenses.

*Although banks are required to collateralize overdrafts, the Federal Reserve has put caps on the size of daylight overdrafts. In addition, the Fed has started to charge fees for daylight overdrafts.

by central banks during the day to avoid a buildup of intraday liquidity shortfalls. At the moment, central banks generally aim to eliminate liquidity shortages in the course of the day, thus enabling banks to square their end-of-day position or meet imposed reserve requirements.62

A general liquidity shortage in the money market during the day could cause settlement delays. For example, suppose that banks have pledged $10 billion of securities as collateral at the central bank. Suppose further that a minimum amount of $8 billion of intraday liquidity is needed for a timely settlement of payments. If a shortage in the money market of, say, $4 billion occurs during the day, the payment system, in effect, will have to operate on $6 billion of intraday liquidity, rather than on the $10 billion provided by the banks. This reduction in intraday liquidity can severely delay the settlement of payments.
In an RTGS environment, the central bank will have to relieve almost instantaneously any shortage that is caused by payments to the Treasury or currency flows to avoid settlement delays—unless it increases its eligible paper holdings to minimize the problem. But even if the central bank relieves the shortage by injecting reserves into the money market, a mechanism will be needed to channel funds to banks that need them to make payments. That is, a well-functioning, daylight interbank market will be needed to redistribute reserves from surplus banks to deficit banks.

**Reserve Balances**

Reserves that are specified by central banks are maintained by other banks in one of two ways: under a binding monetary reserve requirement imposed by the central bank or as a voluntary clearing balance. An important question for countries that are operating or implementing an RTGS system is whether their future reserve holdings, whether required or voluntary, will provide sufficient intraday liquidity to support such a system. Countries with well-developed financial markets that generate a substantial payment volume need more reserves for the smooth running of an RTGS system than countries with a relatively small payment volume.

The reserve requirements of France, Germany, Italy, Switzerland, the United Kingdom, Japan, and the United States vary significantly (see Table 6). Commercial banks in Italy are subject to the highest reserve requirement—17.5 percent of deposits. Consequently, the daily turnover of reserves—defined as the payment volume divided by the stock of reserves—is very low in Italy—only 0.9. Germany also has a relatively low turnover of reserves—7.8. While France has a medium turnover ratio of 37.8, Japan, Switzerland, the United Kingdom, and the United States have high turnover ratios ranging from 65 to 100.

The current reserve requirements of individual European countries will have to be harmonized as part of a common monetary policy in the third stage of EMU. EMI has not yet decided on the need for a reserve requirement as an instrument of monetary policy, nor has it determined the appropriate size of such a requirement. But once a common reserve requirement is implemented, banks probably would be allowed to use reserves intraday for settlement purposes.
Table 6. Reserve Requirements in Selected Countries
(Values in billions of U.S. dollars)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>3.4 (5.4)</td>
<td>37.3</td>
</tr>
<tr>
<td>Germany</td>
<td>5 percent for sight deposits</td>
<td>26.3 (54.6)</td>
</tr>
<tr>
<td></td>
<td>2 percent for savings deposits</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>17.6 percent for all deposits</td>
<td>67.7 (105.4)</td>
</tr>
<tr>
<td>Japan</td>
<td>0.05 to 1.3 percent for sight and savings deposits</td>
<td>29.7 (22.9)</td>
</tr>
<tr>
<td>Switzerland</td>
<td>2.5 percent for short-term deposits</td>
<td>1.5 (1.4)</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0.35 percent for deposits</td>
<td>2.2 (2.2)</td>
</tr>
<tr>
<td>United States</td>
<td>0 to 10 percent for sight deposits</td>
<td>27.4 (23.4)</td>
</tr>
<tr>
<td></td>
<td>0 percent for savings deposits</td>
<td>33.1 (26.8)</td>
</tr>
<tr>
<td></td>
<td>0 percent for time deposits</td>
<td></td>
</tr>
</tbody>
</table>

*In addition to reserve balances held at the central bank, some central banks (Germany, Switzerland, United States) allow banks to apply part of their vault cash to fulfill the reserve requirement.

*The figures within brackets refer to 1980.

*U.K. banks are required to keep a small Cash Ratio Deposit with the Bank of England, which is meant to generate income for the Bank to cover its operating expenses.

*The figures refer to sight deposits in banks with deposits from 0 to 50.1 million and 10 percent for sight deposits in banks of more than 50.1 million.

*Exclusive of required clearing balances. Data on most lines include required clearing balances. These are excess reserve deposits used for clearing balances to avoid overdrafts. These earn a market-based yield that the banks can use to pay for Federal Reserve charges for banking services.


Reserve requirements are usually regarded as a tax on the banking sector, as reserves typically yield zero or below market interest rates. Of the central banks of the countries noted above, only the Banca d’Italia pays interest—at a rate slightly below market rates—on required reserves, but it pays no interest on free reserves.
Range of Securities Eligible as Collateral

As a second source of intraday liquidity in the newly-designed European RTGS systems, central banks will provide collateralized daylight overdrafts. The banks will then, in effect, convert collateral pledged by commercial banks into central bank money that can be used for settlement during the day. A crucial issue centers on which securities are classified as eligible for use as collateral. In selecting the range of eligible securities, the central bank looks principally at the creditworthiness of the issuer. Not surprisingly, government securities appear prominently on the lists of eligible securities (see Table 7).

While France and Italy restrict, at least initially, the range of eligible securities to government issues, Germany and the United Kingdom accept other marketable assets as collateral. In Germany, commercial banks are allowed to use unused Lombard loan facilities for payment cover during the day. The Bundesbank grants Lombard loans against the pledging of government securities (Treasury bills, Treasury bonds, and Treasury discount paper), bills of exchange, and eligible bonds. The Bank of England will accept U.K. Treasury bills, eligible local authority bills, and eligible bank bills as collateral. These bills represent basically the same range of assets that the Bank is prepared to buy in its daily open market operations. In addition, the Bank will accept U.K. gilts that are denominated in pound sterling and U.K. foreign-currency marketable debt as collateral for daylight overdrafts.

European central banks participating in the European Monetary Institute are exploring the possibility of adding securities that are issued by foreign governments to the list of those eligible as collateral. But they have not yet considered whether or how far they should harmonize the range of eligible securities. A lack of harmonization can create disadvantages for banks that are headquartered in one EU country and seek access to the RTGS system in another EU country. The reason is that banks typically keep most of their liquid assets in their home country and thus have only a limited amount of securities available in host countries. One way to give banks access to the RTGS systems of other EU countries is to allow them to pledge collateral at their home central bank for overdrafts that are granted by host central banks. This solution could be implemented if European RTGS systems are linked during the third stage of EMU.

Electronic book-entry securities-settlement systems, in conjunction with securities depositories, are crucial for flexible and cost-efficient pledging of collateral at central banks. The United Kingdom and
France already have well-functioning book-entry systems, which allow for the transfer of securities in real time. The Bank of England operates the CMO for the transfer of market instruments and the CGO for the transfer of giltts. The Banque de France operates SATURNE for the transfer of Treasury and other bills; Treasury bonds and other long-term notes are transferred through RELIT, which is privately operated. The real-time properties of the U.K. and French book-entry systems enable banks to pledge extra collateral or withdraw any unused collateral during the day. The Bank of England and the Banque de France plan explicitly to allow for such intraday flexibility.

The Banca d’Italia introduced a centralized securities accounts procedure (CAT) for the real-time transfer of government securities in 1990, but the system is not yet widely used. In Germany, book-entry transfers of securities are carried out by the Deutscher Kassevein AG (DKV), but the DKV is not capable of transferring securities in real time. German banks typically change their amount of Lombard paper only once or twice a week.

The effectiveness of collateral in limiting credit risk is dependent on both the quality of the collateral and the enforceability of the lien. The Bank of England and the Banque de France will provide liquidity to banks participating in the payment system via intraday repurchase agreements (repos). In intraday repos, banks acquire central bank money through the sale of securities to the central bank at some point.

<table>
<thead>
<tr>
<th>Country</th>
<th>Securities</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>1 Treasury bills&lt;br&gt;2 Treasury bonds</td>
</tr>
<tr>
<td>Germany</td>
<td>1 Bills of exchange&lt;br&gt;2 Treasury bills&lt;br&gt;3 Treasury discount paper&lt;br&gt;4 Government bonds&lt;br&gt;5 Eligible bonds (in DM)</td>
</tr>
<tr>
<td>Italy</td>
<td>1 Government paper&lt;br&gt;2 Government guaranteed paper</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1 U.K. Treasury bills (in £)&lt;br&gt;2 Eligible local authority bills&lt;br&gt;3 Eligible bank bills&lt;br&gt;4 U.K. giltts (in £)&lt;br&gt;5 U.K. foreign currency marketable debt</td>
</tr>
</tbody>
</table>

in the day and repurchase the same securities before the close of business. This is a legally sound way of pledging collateral, because the ownership of the securities is transferred from the borrower to the lender.

Case Studies of the Cost and Availability of Intraday Liquidity

Banks have an incentive to economize on their liquidity holdings, because maintaining intraday liquidity balances is expensive. Collateral requirements involve an opportunity cost, as securities offered as collateral are tied up in the payment system and are no longer available for alternative purposes, such as trading, during the day. Moreover, securities that are eligible as collateral typically trade with a liquidity premium compared to ineligible securities with similar risk characteristics. If the range of securities is narrow compared to the amount of intraday liquidity needed, this liquidity premium can be substantial. The actual cost of intraday liquidity also is influenced by the financial market’s stage of development. Well-developed financial markets generate larger payment flows and hence have a larger absolute need for intraday liquidity. Furthermore, well-developed markets create more trading opportunities for securities (which are tied up as collateral) and thus increase the opportunity cost of collateral.

Three country case studies illustrate the relationship between the cost and the amount of intraday liquidity. The first, Switzerland, describes this relationship in the context of an RTGS system that operates only with reserves. The second, the United Kingdom, suggests what the relationship may be in the context of an RTGS system in which the main source of intraday liquidity will come from collateral holdings. The third, Germany, clarifies the relationship in the context of a combination of high reserve balances and large collateral holdings.

Switzerland. Before the introduction of the new RTGS system, SIC, Swiss banks held reserve balances on the order of Sw F8 billion at the Swiss National Bank. Since SIC was introduced and reserve requirements were lowered, these balances have dropped to approximately Sw F2 billion. At present, the daily turnover ratio of reserves is approximately 60 to 70 times per day on an average day and up to 100 times on peak days. Swiss banks keep the level of reserves to a minimum by just meeting the low reserve requirement. Like most other banks, they prefer to optimize their payment flows (by changing the input sequence of their payment orders or splitting large payments) and rely on queuing facilities, rather than acquire additional reserve balances at a
cost equal to the short-term interest rate. (In addition, some large Swiss banks prefer to bilaterally net some payments on an informal basis to reduce their payment volume.) But heavy reliance on queuing has led to delays in the settlement of payments.76 As long as banks face an opportunity cost equal to the full interest forgone on free reserves, they are unlikely to increase their reserve balances. Therefore, the delays in SIC can be expected to continue.

The United Kingdom. In the United Kingdom, CHAPS plans to shift from net settlement to real-time gross settlement in 1995-96. During 1994, the daily payment flow on CHAPS averaged about £100 billion. Initial estimates indicate that U.K. banks will need about £10 billion of intraday liquidity to guarantee timely settlement of payments under real-time gross settlement. The current reserve holdings by banks amount to £1.4 billion, so banks must pledge collateral up to £8.6 billion. The opportunity cost of collateral may amount to 25 basis points on an annual basis. This estimate is based on two types of evidence. The first type is a comparison of the discount rate on eligible bills with the rate on non-eligible bills. This yield differential is presently about 25 basis points. The second type of evidence is a comparison of the yield on eligible bills with the yield on equivalent money market assets, such as CDs. Over the last three years, this spread has ranged from 0 to 50 basis points and has averaged around 25 basis points.77 Assuming that the collateral constraint is binding, the total annualized cost of collateral holdings of £8.6 billion would then be £21.5 million.78

Germany. German banks are required to maintain relatively high reserve balances of DM42 billion. These banks have lodged about DM444 billion in securities at the Bundesbank.79 On average, DM140 billion is used for open market operations; the remaining DM300 billion is available for Lombard credit lines (overnight and intraday). The available amount of reserves and collateral is large compared with the average daily payment flow of DM600 billion in Germany's electronic netting system, EAF. The opportunity cost of pledging collateral is relatively low in Germany, since German financial markets are less developed. At the moment, the cost of intraday liquidity is not very large for German banks, but this cost may change in the future with more active financial markets and rising payment volumes.
V. The Differential Impact of Overdraft Charges and Collateral Requirements on the Liquidity of Financial Markets

The United States and various European countries have embarked on two different methods for reducing the risk faced by central banks in RTGS systems. Both methods give users of these systems incentives to avoid tapping daylight credit from central banks, but they differ in two important respects.

The two methods will not have the same effect on central banks’ credit risk. The Federal Reserve allows uncollateralized overdrafts, but it levies a charge for the average amount of overdrafts during the day. Thus the Fed will continue to bear credit risk, but it will be partially compensated by overdraft receipts. By contrast, various European central banks will allow overdrafts that are collateralized by eligible paper, but they will not levy a finance charge. Thus these banks will eliminate their day-to-day credit risks in operating their RTGS systems, but they will forgo revenue from overdrafts.

The two methods also will have different impacts on the pricing of money market instruments. The Federal Reserve method will tend to increase yields on Treasury securities relative to non-Treasury securities, while the European method will tend to reduce yields on Treasury and other eligible securities relative to non-Treasury securities. In addition, in the United States, bid-ask spreads on Treasury and other liquid securities likely will widen more than
bid-ask spreads on less liquid securities. In Europe, bid-ask spreads on eligible securities will widen by less than spreads on ineligible securities.

Charges for Overdrafts

For the myriad intuitions that inform the above-noted conclusions, consider first the system in the United States. Treasury securities typically are the most liquid securities and therefore carry a liquidity premium in their prices, a relatively low yield, and relatively narrow bid-ask spreads. Liquidity is provided by a massive trading and dealer financing operation for Treasury securities, which means that trades in Treasury securities generate a large share of the overdrafts in payment systems. Alternatively stated, the existence of unpriced overdraft facilities in payment systems is one of the underpinnings of Treasury security liquidity.

In the case of the United States, charging for overdrafts amounts to a charge on the most liquid securities, for these securities generate the largest share of total payment volume. Banks will pass this charge to dealers, who must respond by widening spreads to cover the added costs. But then the Treasury securities will have become less liquid, so their yields must rise to compensate the ultimate holder for this erosion in quality. Less liquid securities—non-Treasuries and off-the-run Treasuries—will on average attract a far smaller pass-through of overdraft charges, because trading in them is less frequent. Thus, their yields should rise less than the yields on liquid securities. In summary, a charge on payment services affects securities that generate extensive payment flows more strongly.

The rise in yields of Treasury securities payable by the Treasury on new issues will offset, to some extent, the revenues from the charges on overdrafts that the Federal Reserve takes in to cover its risk on the payment system. Prior to the levying of overdraft charges, losses that might have occurred on the payment system would have been covered first from the revenues of the Fed, second from its surplus, and finally from its capital. Indirectly, these losses would have to be borne by the U.S. Treasury in the form of reduced contributions from the Fed or, if serious enough, directly through a recapitalization of Federal Reserve banks. Under the current system, payment for such liquidity support is charged to the dealer and, in a pass-through, to the ultimate holder of the securities, with the revenues passed from the Fed directly or indirectly to the Treasury. If demand for Treasury securities is perfectly elastic, yields must
rise to compensate the holder for the added costs of acquiring payment system liquidity. Thus for the consolidated Treasury-Fed, net revenues from this charge are zero, and there exists no additional compensation for bearing the risk to the payment system that may arise from settling Treasury securities.

If demand for Treasury securities is not perfectly elastic, both holders of Treasury securities and the Treasury will bear the added costs of using the payment system, and the added cost to the Treasury from the rise in yields on Treasury securities will not offset completely the revenue gains from the charge for overdrafts. Because the market for Treasury securities is the most liquid market in the United States, and because other liquid dollar securities also must face the added payment system charges, this is the more likely case. Overall risk to the U.S. Treasury and the Fed from Treasury security trading may decline if the incentives created by overdraft charges reduce overdrafts. Nevertheless, the overall risk to the Federal Reserve and the Treasury from overdraft default probably has been reduced very little by overdraft charges. The feared large losses most likely will be incurred when a large bank fails or during a liquidity crisis, when payment traffic is abnormally high and imbalances are in unusual dimensions. Under such conditions, the charges are not a disincentive for a failing bank to fire out payments.

Transactions in private securities also will incur added costs, because they make use of payment system overdrafts. Again, these costs must be covered by a widening in dealer spreads and, because of the implied reduction in liquidity, by a rise in yields. To the extent that transactions in private paper cannot escape the use of overdrafts, charging for overdrafts amounts to a tax on private finance—the increased yields that issuers of private securities must pay are, unlike the Treasury, not compensated by the overdraft revenues. Nevertheless, because it typically is less liquid than government paper, the average private security will be traded much less than a government security and thus will incur the overdraft charge much less frequently. Therefore, spreads and yields on private paper will increase less than on Treasury paper.

The Federal Reserve initiated its system of charging for daylight overdrafts on April 14, 1994, beginning with a charge of 24 basis points at an annualized rate for average overdrafts during a 24-hour day less an allowance based on bank capital. Because Fedwire is open for business for ten hours, this charge amounts to approximately ten basis points annualized for average overdrafts during business hours. Separating the effect of the imposition of charges for payments
from other effects on interest rates is difficult, but between April 13 and April 14, 1994, yields increased about two basis points on short T-bills, about one basis point on one-year bills, and from two to four basis points on longer maturities. If settlement of these securities leads to an overdraft that lasts for two hours, the two-basis-point increase in yield is consistent with the imposition of overdraft charges.14

Collateralization for Overdrafts

Consider next the effects of imposing 100 percent collateralization on overdrafts on RTGS systems, as planned in various European countries. Though some private paper will be eligible as collateral, the present discussion refers to eligible paper as government securities, because such securities probably will comprise the bulk of eligible paper. Moreover, the discussion assumes that the increased usefulness of such paper in allowing overdrafts will increase banks' demand for it.5

For overdrafts incurred by DVP transactions in ineligible securities, the deposit of an eligible security is required. Since government securities are generally more liquid than other securities, they will pay lower yields than other paper. To support payment traffic, a reserve of government securities beyond the amount held under the current system will have to be held, and the cost of this reserve—the spread multiplied by the value of the reserve—will have to be charged on a pro-rata basis to those transactions that incur overdrafts. Dealers in ineligible paper will cover this cost by widening their bid-ask spreads, and the loss of liquidity will raise the yield on ineligible paper. If ineligible paper is illiquid, it will trade little and make relatively rare use of overdrafts; the bid-ask spread and yield increases therefore will be relatively small. In addition, if operational adjustments can be made to avoid the use of overdrafts, trading in ineligible paper will add little to the demand for eligible paper. Nevertheless, the added costs of avoiding the use of overdrafts will have to be covered by widened spreads, so a reduction in the liquidity of ineligible paper cannot be avoided.

For government securities, the story is different. Demand for such securities by banks must increase because of the need for government securities for overdraft operations that result from trading in ineligible securities and general interbank payments. For this reason, the yield on government securities must fall. On the other hand, the liquidity of the market in government securities also is reduced by the new collateralization rules. As the most liquid of the securities, trading in government securities typically will generate the greatest use of overdrafts.
Thus, trading in government securities will itself require a reserve of such securities to allow access to overdrafts. This reserve, however, can be a much smaller fraction of the maximum overdrafts generated by trading in government securities, because securities acquired in daytime settlements can in turn be mobilized immediately for delivery as collateral for further overdrafts. Nevertheless, the costs of the reserve of government securities that are held to manage overdrafts incurred by trading in government securities must be covered by an increased bid-ask spread in government securities. Because overdrafts from trading in government securities require only a fractional reserve of such securities, this spread increase will be smaller than that for ineligible securities of equal liquidity. Since government securities are generally more liquid than ineligible securities, however, they generate far more overdrafts on average. Thus, on net, we cannot predict which of the bid-ask spreads will increase most. The decline in yield on government securities will occur so that nonbank holders will release these securities to banks, whose demands for them will increase. To hold government securities after their liquidity has been reduced, the public usually will require a higher yield. But ineligible securities also will become less liquid, so the public may be content to hold the government securities without a higher yield. A reduction in yield is needed to reduce the amount of government securities in the hands of the nonbank public and move them to banks.

The European method of collateralization favors government and other eligible securities over private securities. The treasuries reap a direct pecuniary gain from reduced financing costs, and central banks eliminate the credit risk that they face on the system. Unlike the reforms in the United States, where the Treasury and the Federal Reserve enhance their revenues to cover the service of bearing credit risk in payment system operations, the collateralization method in Europe enhances treasury revenues, while abandoning, in normal situations, the service of bearing credit risk in payment system operations. In a severe situation, like the ERM crisis, however, there may be insufficient collateral to manage payment traffic. Collateral may have to be delivered to the central bank in overnight discount operations, and uncovered payment traffic may surge. In this case, there must be an escape, whereby the central bank provides uncovered credit rather than allows the payment system to seize up. In such a situation, weak institutions would be expected to collapse, leaving the central bank with an uncovered loss borne on the payment system. To prepare for this eventuality, it may be desirable to use interest charges to establish a loss reserve.
VI. Conclusions

The growth in the volume of national and cross-border financial transactions during the 1990s and the corresponding increase in the size of flows through the world’s principal wholesale payment systems—domestic and international—have led the major central banks to focus on the risks inherent in current wholesale payment arrangements. By now, it is well-recognized that any interruption in wholesale payments, due to an operational mishap or the failure of a major counterparty, carries with it the threat of a payments gridlock that ultimately could have serious consequences for the real economy. This threat has provided the urgency for the ongoing reform of wholesale payment systems.

The objective of these reforms has been to reduce the credit risk associated with the growth in intraday credit exposures that arises in net settlement systems and in real-time, gross settlement systems when the central bank provides daylight overdrafts. To reduce intraday, payments-related credit in net settlement systems, central banks have sought to transform these systems into RTGS systems with collateralized overdrafts. In existing RTGS systems, risk reduction has taken the form of caps on the size of uncollateralized daylight credit and charges on such overdrafts.

In evaluating the success of current efforts to strengthen the world’s wholesale payment systems, three related issues must be taken into consideration. The first issue is that reductions in systemic risk, which result from reductions in payments-related, intra-day credit exposures, come at a price. In particular, a reduction in
payments-related credit reduces liquidity in financial markets—that is, it increases bid-ask spreads for financial instruments roughly in relation to the share of daylight overdrafts that arise as a result of trading in these instruments. Payment patterns can be altered to lower overdrafts, but trading patterns in securities markets cannot easily be rearranged. Yet separating the timing of securities transactions from the timing of payments would only increase settlement risk.

In any event, intraday credit has economic value; therefore, intraday credit markets are likely to develop: payments that are made early in the day may command a discount, while payments that are made late in the day may command a premium. A quantitative analysis of the relation between the size of payments-related overdrafts and liquidity in financial markets has proved elusive thus far, but once data from ongoing experiments become available, such an analysis will be both possible and beneficial.

The second issue that must be taken into account in evaluating the success of ongoing and planned reforms is that they may lead to private sub-netting systems. Such systems may be established as low-cost alternatives to RTGS systems, where the cost of daylight credit has been increased through collateralization or interest charges on overdrafts. Thus, determined efforts to reduce daylight credit in central banks’ wholesale payment systems may only shift such credit into private netting systems. While central banks can regulate these private systems, doing so might distort payment patterns. Managing risk in an environment where it can be clearly observed may be preferable.

The third issue that must be taken into account in evaluating the success of reforms is that they may encourage the redenomination of financial transactions into U.S. dollars. As noted above, reforms will produce two types of payment systems: the proposed European RTGS system in which central banks supply collateralized, interest-free overdrafts, and the U.S. RTGS system in which the Federal Reserve charges interest on uncollateralized overdrafts. At planned levels of interest charges and at planned collateral requirements, the proposed European system could be more expensive for users than the existing U.S. system. In that case, dollar-denominated wholesale payments would be cheaper to execute and settle. This would be particularly true for money market transactions: the high degree of liquidity in U.S. money markets and dollar forex markets makes it possible for money market transactions in less liquid currencies to be synthesized or replicated in dollar markets. In short, the greater the advantage flowing from the dollar wholesale payment system,
the greater the incentive to redenominate financial transactions in dollars. Hence, the challenge is to set interest charges and collateralization requirements at levels that would not generate distortions in the choice of currency in which to denominate financial transactions.

The main cost of reducing payments-related credit is its negative impact on market liquidity. The main benefit of reducing such credit is that a financial disturbance, such as the failure of a major institution, would no longer pose the threat of payment gridlock in a large part of the financial system. Once this threat is minimized, central banks will no longer need to stand ready to rescue a large number of institutions that are perceived to be too big to fail. Payment system reforms thus hold the promise of strengthening the market mechanism in banking and finance and of reducing the extent of the financial safety net.

While payment system reforms have been largely successful, a host of technical issues have yet to be addressed. Some of these issues arise in the context of continued growth in international cross-border payments and securities transactions. This growth will require the linking of the major RTGS systems (for example, the linking of Europe’s national RTGS systems under TARGET) and the linking of RTGS systems with securities settlement systems to put transactions on a delivery-versus-payments basis.

Another set of issues arise in the context of the increase in national RTGS systems. At the moment, only a few commercial banks are members of more than one of these systems, but the number of such banks will likely increase. With the globalization of securities markets, banks will need to keep collateral balances in European-type systems. Yet doing so will be highly inefficient for global institutions, as these balances could remain idle most of the time. Thus arrangements for a global collateral pool may have to be explored.

The successful resolution of all these issues will require continued cooperative efforts among the major central banks.
End Notes

1 See the Committee on Interbank Netting Schemes of the Central Banks of the Group of Ten Countries (BIS, 1990).

2 The main objective of the Lantafalussy standards are that the participants and the service providers should have both the incentives and the capability to manage credit and liquidity risks arising from netting schemes.

3 The U.S. Federal Reserve grants daylight credit to Fedwire participants, and the Bank of Japan stands ready to ensure settlement on Zengin (one of Japan’s main large-value payment systems). The systems for foreign exchange transfers in these countries, CHIPS and FIEYS respectively, rely on loss-sharing among the surviving participants in case of a settlement failure without an explicit central bank guarantee. If the central bank does not grant any credit on its main domestic payment system—for example, SIC in Switzerland—there is no need for separating foreign participants for the purpose of segregating risks.

4 Most interbank payments through BOJ NET are settled on a net basis at four designated settlement times during the day; others are settled on a real-time gross basis.

5 The United Kingdom introduced its electronic large-value, funds transfer system, CHAPS, in 1984 and shifted all its payment flows to it in 1995. Switzerland introduced its electronic gross-settlement system, SIC, in 1987, phasing out some paper-based payments. Germany has been settling the majority of its payments via its electronic netting system, EAF, since 1990. In January 1992, the Bundesbank introduced the Elektronische Counter as a means of accessing its express electronic intercity credit transfer system, ELCH-ZV (BIS, 1993b). Italy introduced two electronic netting schemes, MPS and Electronic Memoranda, and one electronic gross-settlement scheme, BISS, for large-value payments in 1989-90. At the same time, it undertook efforts to shift interbank payment flows that were settled across bilateral correspondent accounts to the new payment networks, thereby promoting the daily settlement of payments to central bank money. France still settles its domestic large-value payments on a paper basis via the Paris Clearing House, a practice that the Banque de France and other French banks intend to discontinue. But international payments in French francs have been settled electronically via SAGITTAIRE since 1984. SAGITTAIRE is currently the only automated system in France for large-value payments.

6 In 1987, Japan introduced electronic payments on the Zengin system, which is operated by private banks to clear third-party domestic payments. The Bank of Japan initiated on-line transfers on its BOJ NET in 1988. The FIEYS of the Tokyo Bankers’ Association began clearing and settling electronically through BOJ NET in 1989.

7 See, for example, Angelini (1994).

8 SIC payment flows on a U.S. public holiday are approximately 10 percent of payment flows on a normal day (see BIS [1990b]). While the SIC system closes at 3:00 P.M. local time for same-day value payments, the dollar leg of U.S.-Swiss franc transactions is usually routed via CHIPS, which settles at 6:00 P.M. EST, so a delay in the settlement of the Swiss franc leg even reduces the cross-currency Herstatt settlement risk of such transactions.

The banks are not prevented from phoning each other to find out whether any payments are pending in the queue.

See Banca d'Italia (1994).


The figures reported in both tables 3 and 4 refer to 1992, but some of the figures differ for two reasons. First, not all foreign exchange transactions are captured in table 4 (cross-border turnover). Second, not all forex trades lead to settlement through national payment systems as reported in table 5 (daily payment flows). Rather, some transactions are netted on a bilateral or multilateral basis before settlement, while others, such as currency options, are not always settled in full.


For example, if dollars that are due for delivery in New York are not settled because of a failure to settle in Tokyo, a problem in the dollar settlement system may be created, as the recipient must scramble for funds to cover outstanding dollar payments.

See Glass (1994).

See Duncan (1994) and Glass (1994).

See Group of Thirty (1989).


See BIS (1992) and (1993b).


Initially, the caps were set at three times capital. Since this multiple coincided with the current ratio of overdrafts to capital, the limit was binding only on future leveraging of overdrafts.

See Gerber and Weisbrod (1992) and Schoenmaker (1993) for an extensive analysis of risk management in CHIPS.


For payment overdrafts related to book-entry securities transactions, banks may present collateral as cover; such covered overdrafts are excluded from the overdrafts to which caps apply.

The monitoring system also has the capability of either selecting a payment and removing it from the system or quashing the payment until sufficient funds are received into the paying bank’s account.

The ten basis points rate is charged for average overdrafts during the business hours of Fedwire. As Fedwire is open for ten hours, a rate of ten basis points during the day is equivalent to an annualized rate of 24 basis points.

Hancock and Wilcox (1995) estimate an average reduction of $17 billion from the April 13, 1995 fee increase but indicate that this reduction is not statistically significant.


See, for example, Bank of England (1993).

A way out of this problem is to re-route payment flows. A sending bank that has hit the bilateral receiver cap set by the beneficiary bank can route payments to the beneficiary bank via a third bank that is willing to accept payments from the sending bank and whose bilateral cap with the beneficiary bank leaves room for these payments. Alternatively, the sending bank can make collateral available to the beneficiary bank to support any payments beyond the bilateral cap. Heavy use of such re-routing techniques, however, would defeat the efficiency of netting systems.

An example of legal risk in net and gross settlement systems is the zero-hour clause in some EC countries—for example, Italy and the Netherlands. The bankruptcy laws in these countries may retroactively delete the transactions of a closed institution from 1100 A.M. on the day that the institution is ordered to be closed. See Committee of EC Central Bank Governors (1992a).


More generally, payment-versus-payment mechanisms that link payment systems from different countries to eliminate Herstatt risk also are vulnerable to this externality.


In the original plans for TBF, the Banque de France proposed a partial collateralization of overdrafts. See Committee of EC Central Bank Governors (1992b). Recently, the Banque de France decided to require full collateralization of overdrafts in TBF.

See Hartmann (1994).

Each Bundesbank branch is involved in account keeping and processing of payments via EIL-ZV, which is a decentralized system. Over the next three years, the Bundesbank plans to move to a centralized structure of account keeping and processing. The transition would significantly facilitate liquidity management by banks, which would then only have to fund and monitor a single account at the Bundesbank, rather than a multiplicity of accounts at different Bundesbank branches.

See Hartmann (1994).

To reduce risk, such bilateral netting must have a sound legal basis. The bilateral netting procedure is said to be permissible under German law (Hartmann [1994]) and has been accepted in cases of insolvency—for example, the failure of Bankhaus Herstatt in 1974.

The Bundesbank expects that 75 percent of the total payment volume will be settled bilaterally during the day (Hartmann [1994]).

See Banca d’Italia (1994).

See BIS (1992b). In 1993, the Nederlandsche Bank took over the 8007 System, a net settlement system for international payments. Eventually, these payments also will be routed through the revised Central Bank System.


Austria, Finland, and Sweden joined the European Union in 1995. These new entrants are not included in our analysis.


See Schoenmaker (1995). Potential additional risk reductions in RTGS systems via DVP transactions are not included in this estimation.
Denmark’s Nationalbank currently provides uncovered daylight credit in its RTGS system, but it is considering the implementation of a collateral requirement.
See Angelini (1994) and Schoenmaker (1994).
In April 1994, the Federal Reserve started to charge an explicit intraday fee of ten basis points for banks’ average daylight overdrafts. After the introduction of this fee, peak overdrafts fell on average by 40 percent. No significant decline in these overdrafts occurred after the Fed increased the fee to fifteen basis points in April 1995.
For example, when repurchase agreements or bills obtained by a central bank in its open market operations mature, they are usually repaid at the beginning of the value day, thereby creating a reserve flow from the banking sector to the central bank early in the morning. New operations, which generate new reserves, may be made later in the day. But a reserve shortage exists from the time that the old repurchase agreements or bills mature until the time that the new operations are executed.
The need for active central bank intervention to relieve money market shortages may be less pressing when sufficiently large backup facilities, such as unused Lombard credit (see note 63, following), are available. A Lombard loan or credit is an advance against the collateral of specifically listed securities. The interest rate on this type of loan is typically low since the collateral is highly liquid. Commercial and central banks in Europe frequently use this type of credit.
If banks that need funds to make payments have fully used their interbank credit lines with all other banks, they will not have access to the newly injected liquidity in the money market.
During the last decade, reserve requirements have been lowered around the world to avoid the distortions—notably, disintermediation and de-localization—that they create. See Keesman (1992).
This relationship will be positive, though non-linear. For example, it might follow the square-root relationship of a simple inventory model.
A full discussion of the issue of whether reserve requirements form an essential instrument of monetary policy is beyond the scope of this paper. The Bundesbank recently reduced its reserve requirement but stated that "minimum reserve requirements remain an important policy instrument for ensuring the effectiveness of monetary policy in the long run." See Deutsche Bundesbank (1994b). Some of the other European central banks may see less need for reserve requirements.
The tax argument is based on the assumption that requirements are binding. In general, however, banks want reserves. Consider that the daily turnovers of bank deposits at the Bank of England and the Federal Reserve are similar but that reserve requirements are much higher in the United States than in the United Kingdom. Apparently, U.S. banks demand the deposits that they hold for clearing balances. If reserve requirements are not binding, then the tax only takes the form of a zero interest payment and not the form of an excess holding of reserves. If central banks supply services such as free overdrafts, however, the zero interest payment on reserves is not a tax; rather, it is a fee for services rendered.
Other factors that may be taken into account are interest risk and foreign exchange risk. For example, the value of bonds is more sensitive to changes in interest rates or interest rate expectations than the value of bills. A central bank can try to protect itself by taking a haircut on assets that are more exposed to these risks.

Eligible bills are backed by three parties that are “known to be solvent”—that is, subject to audit, with a maturity of less than three months. Bonds that meet certain minimum standards, such as marketability and issuer’s creditworthiness, are eligible as collateral. These bonds are typically issued by state or government-related banks.

Eligible bank bills are commercial bills that are guaranteed, or accepted, by a U.K. bank.


More generally, a repo consists of the acquisition of immediately available funds through the sale of securities with a simultaneous agreement to repurchase the same securities.

Both the Bank of England and the Banque de France are prepared to release securities that banks wish to trade and to accept substitute securities intraday. Although their book-entry systems can handle such transfers in principle, the question is how much time the transfers will require and how much they will cost.


The Swiss National Bank (Monthly Bulletin, July 1994) reports that the banking system as a whole was holding 25 to 30 percent excess reserves in the first half of 1994. But the figures vary depending on the size of the bank. Large banks, for example, have reduced their excess liquidity to nearly zero since the beginning of 1993.

In 1993, on average, only 81 percent of payment volume was settled by 2:00 P.M. while 99 percent of volume was initiated by that time. See Vital (1994).

Schmidt (1994).

The cost is calculated over the incremental amount of securities needed under real-time gross settlement. Banks are currently holding certain eligible securities for particular purposes—for example, for open market operations with the Bank of England or for liquidity management. One can assume that banks will continue to hold these securities available for these purposes and will demand extra securities to be used as collateral in the payment system.

In the case of the United Kingdom, there may be in fact be no need for the banks to acquire incremental eligible securities to cover the day’s payment overdrafts. The domestic settlement banks (all CHAPS settlement banks except Citibank, Deutsche Bank, and Credit Lyonnais) keep £1 billion as a cash ratio deposit with the Bank of England and £1.3 billion in Treasury bills and £7.5 billion in eligible bank bills as “primary liquid assets” to meet a liquid asset ratio for prudential reasons. Although the Bank of England has no officially published liquidity requirement, it requires the large clearing banks to keep about 8 percent of eligible liabilities in primary liquid assets. The exact percentage varies from bank to bank and is set by the Bank of England. In addition, clearing banks keep £7.8 billion of gilt. All these assets can be used as collateral for overdrafts while still satisfying the primary liquidity requirement. Thus £17.8 billion is available for the payment system, but it is estimated that only £0 billion is needed.

Only if banks use their stack of liquid assets for active liquidity management during the day might there be an incremental demand for securities that are eligible for collateralizing overdrafts. It may be that the current liquid security holdings are too cover an extreme need for overnight
funds in the presence of a liquidity shortage. If such an event indeed occurred, a payments gridlock might occur on the next day, because banks would lack the securities to unlock overdrafts. To cover this worst case scenario, banks might increase their normal stock of eligible securities.

38 Deutsche Bundesbank (1994b).
39 Japan, whose payment systems are almost entirely on a net settlement basis, has not yet embarked on a similar risk control policy. But the Bank of Japan is interested in strengthening its RTGS operation. See Aziz (1996).
40 To complete a commercial bank analogy, the Federal Reserve might wish to hold those added revenues to accumulate a loss reserve sufficient to cover the losses that it perceives it may incur on the payment system through overdrafts. Alternatively, the Fed might wish to pass the revenue to the U.S. Treasury as profit, but it may later require a capital injection from the Treasury if the losses that it fears ever materialize.

41 See Garber and Weissbrod (1990).
42 Putting off DVP transactions until late in the day, delaying the closing out of repurchase agreements, moving from the book entry system to net settlement in Treasury bills, and other measures can emerge to reduce the use of overdrafts from Treasury dealer operations. (A buyer of securities should be willing to pay a higher price for paper that will be delivered later in the day because of the avoidance of the overdraft charge arising from delivery versus payment. For those transactions that cannot be delayed, the buyer will pay a lower price because of the overdraft charge.) Such measures, however, will themselves reduce the liquidity of the Treasury markets and result in wider spreads and higher yields. To the extent that the markets incur the costs to restructure in order to avoid overdraft charges, the increased finance costs of the Treasury will not be offset by increased revenues from the overdraft charge.
43 By April 18, 1994, other forces took over: the Federal Reserve’s monetary tightening raised yields more than 20 basis points above the levels of April 13.
44 It may be that banks already hold a sufficient amount of eligible paper for liquidity purposes and would not expand their holdings, as noted in the discussion of the United Kingdom and Germany. French credit institutions and the mutual funds that they control hold a large amount of Treasury bills, but these institutions cannot readily mobilize the bills from these funds because of regulations that prevent self-dealing.
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