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

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Abstract

This paper reviews the ongoing efforts to reduce the risks inherent in the world's principal wholesale payment systems. The paper assesses the major policy proposals to contain the growth in intraday credit exposures that arises in net settlement wholesale payment systems and in the real-time gross systems in which the central bank provides daylight overdrafts. It also discusses the benefits of these risk-management policies, and we assess the adverse impact of applying interest charges for intraday central-bank credit or of collateralizing such credit on liquidity in financial markets.

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Summary

The growth in national and cross-border financial transactions during the 1980s and the corresponding increase in the size of flows through the world's principal wholesale payment systems have led to major reform efforts. These reforms seek a reduction of the credit risk associated with intraday credit exposures that arise in net-settlement systems and in the real-time gross systems in which the central bank provides daylight overdrafts. Central banks have sought to reduce intraday payments-related credit in net settlement systems by restructuring payment systems into real-time gross settlement systems with collateralized overdrafts. Furthermore, in the existing real-time gross settlement systems, the risk-abatement programs currently in effect have taken the form of placing caps on the size of the uncollateralized daylight credit and of levying charges on such overdrafts.

The main benefit of reducing payments-related intraday credit is that a financial disturbance, such as an operational mishap, the failure of a major counterparty, or a liquidity problem in one of the key money markets, no longer threatens large parts of the financial system with the consequences of a payments gridlock. Payment system reform is the key to strengthening the market mechanism in banking and finance and to achieving a reduction in the cost of the financial safety net.

Three related issues need to be taken into consideration in evaluating the cost of the ongoing reform efforts. First, the reduction in systemic risk, owing to the reduction in payments-related intraday credit exposures, reduces liquidity in financial markets. It increases bid-ask spreads for financial instruments roughly in relation to the share of daylight overdrafts that are due to trading activity in these instruments. Second, the increase in the cost of daylight credit in central-bank-based wholesale payment systems, through collateralization or interest charges, is providing strong incentives to create private sub-netting systems as low cost alternatives to the real-time gross settlement systems with collateralized or interest-bearing overdrafts. Third, since the ongoing and planned reforms will produce two different types of payment systems--the European real-time gross settlement system with collateralized interest-free central bank overdrafts and the U.S. real-time gross settlement system with uncollateralized overdrafts subject to interest charges--there is a risk that incentives are being created for global payments flows to be redenominated to clear through the cheaper wholesale payment system.

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 gross domestic and international payments flows. It now takes around three business days for the interbank funds transfer systems in the major industrial countries to generate turnover equivalent to the country's annual economic output. These flows are facilitated by an interlocking network of national and international wholesale payments arrangements that are at the core of the world's major financial systems.

Central banks have been acutely aware of the possibility 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--might prevent some payments transactions from being completed on a timely basis, which in turn might then affect the ability of other transactors to complete their payments, leading in the end to a payments gridlock that could have serious consequences for global trade and finance.

The principal feature of payment systems 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 system with payments finality guaranteed by the central bank. Financial institutions make intra-settlement-period payments on the anticipation of incoming payments during the period. If at the time of settlement one major institution fails to honor its payments obligations then other institutions that were counting on these payments to cover their outgoing payments may not be able to settle their own payments obligations. Thus the intraday payments-related ballooning of the balance sheets of the major banks carries with it the possibility of a gridlock-inducing domino effect. Alternatively, if the payments traffic goes through the central bank, as it does in the real-time gross settlement system in the U.S., and the central bank guarantees the finality of the outgoing payments, then it assumes the risk of the intraday credit expansion. In the U.S. such intraday credit has recently averaged nearly \$200 billion, and such risk cannot be ignored.

The thrust of the policy reforms in the major countries has been to reduce payments-related credit in their financial system. The first round of reforms, therefore, variously involved limits on the extent of intraday overdrafts on payment systems, requirements of cash-in advance for payments, or requirements for securing credit extended by clearinghouses. The Federal Reserve has begun charging for the extensive overdrafts on its wholesale payment system. The movement toward a single market and a single currency has led the major European central banks to move in the direction of real-time gross settlement payment systems that permit only collateralized overdrafts at the central bank. 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,

and it has strengthened intraday payments finality through a reserve fund and extensive risk-sharing arrangements among its members. In addition, the settlement risk arising in international transactions due to non-overlapping operating hours of national wholesale payment systems (the so-called Herstatt risk), is being reduced by extending operating hours of the major national systems.

A fundamental issue concerning the reduction of intraday payments credit concerns the impact of these reforms on the liquidity of money and capital markets. By making intraday credit more expensive, the policies are likely to reduce the volume of transactions in instruments that are responsible for much of the intraday credit--principally transactions in government securities and foreign exchange. As a consequence, it is to be expected that liquidity in these markets will be somewhat reduced. For example, it is likely that the full implementation of the ongoing reforms will raise the yields on short-dated government securities, as well as increase spreads in the foreign exchange markets. But this may well be an appropriate price to pay for the resulting reduction in the risk of a debilitating payments disturbance.

Although reforms in the technically demanding and unglamorous area of payment systems have been implemented without the fanfare that has accompanied the ongoing 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 in creating sound and efficient financial systems. By strengthening the payment systems in such a way as to reduce the possibility that payments problems arising in one institution might cascade over the wholesale payment system and undermine the soundness of other institutions, central banks have increased their degrees of freedom. Indeed, central banks 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.

This paper first reviews the nature and the objectives of the ongoing and planned payment systems reforms in the United States, Japan, and the major European Union countries (Sections II, III). It then 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 IV). The impact of the ongoing shift toward real-time gross settlement payment systems--the preferred type of system for wholesale payments--on liquidity, on the relationship among yields of securities of varying liquidity, on bid-ask spreads, and on payments conventions in the securities markets is discussed in detail (Section V). The concluding section identifies a number of unresolved issues.

II. Some Basic Operating Principles of Wholesale Payment Systems

In this section, we will present a menu of basic jargon and concepts regarding the operation and control of wholesale payment systems. Our purpose here is to provide a broad outline of the two types of wholesale payment systems and a general view of the risk control principles and procedures that have recently emerged. In later sections, we will present in detail the institutional arrangements--in place or prospective--for particular national systems.

In net periodic settlement systems, participants send payment instructions to each other over a period of time and 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. 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 reduces significantly the need for good funds, because transactors need only have sufficient volume of the settlement medium--reserve balances at the central bank--to settle net amounts at the end of a settlement cycle. Netting arrangements, however, expose the participants to credit risks as they extend large volumes of payments-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 payments flows, i.e., the risk that the failure to settle by one possibly insolvent participant will lead to settlement failures of other solvent participants due to unexpected liquidity shortfalls. Recognizing the systemic risk inherent in netting schemes, central banks of the G-10 countries have formulated minimum standards for netting schemes. 1/ These Lamfalussy standards first stress the legal basis of netting. 2/ 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. Second, multilateral netting schemes should have 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. This will reduce the possibility

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 Lamfalussy 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.

and extent of settlement failures. Finally, multilateral netting schemes should have back-up arrangements to complete settlement in case of failure of a large participant. The non-defaulting participants then have to cover the shortfall at settlement according to a loss-sharing rule. To deal effectively with liquidity problems, such loss-sharing rules are often backed by collateral posted at the clearing house.

In real-time gross settlement or continuous settlement systems (RTGS), 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 the 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 being settlement agent, grants daylight overdrafts to the participating banks by guaranteeing all outgoing payments instructions, which preserves 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 the credit risk within the payment system, but may also significantly reduce the liquidity of the system. If good funds or acceptable collateral are not available, the settlement of payments will be delayed until cover is obtained. This may reduce the volume of transactions in money markets and reduce liquidity in all the major securities markets. Indeed, in an extreme case it may delay the settlement of other payments, and eventually 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 transaction and final settlement. In book-entry systems the transfer of securities occurs by book-entry rather than by a physical movement of securities, and book-entry systems have been increasingly used for the settlement of securities transactions. Securities depositories are established for holding securities at a centralized place and executing book-entry transfers. 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, while other countries route such transactions through their main domestic large-value payment

system. 1/ 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 supervisory wings. 2/

III. Payment System Reforms in the United States, Japan, and Major European Union Countries

In the early 1980s, the increasing attention paid by the Federal Reserve to the risks that it incurred in operating the payment system triggered a general interest within the industrial country central banking community in containing the risk inherent in wholesale payment systems. Monitoring of overdraft positions by the Federal Reserve Banks in the late 1970s and early 1980s had indicated large and growing overdrafts on their real-time gross settlement system, Fedwire. 3/ Simultaneously, the risk of a systemic failure on CHIPS, the end-of-day net settlement system for Eurodollar and foreign exchange payments became evident. 4/ Recognizing these risks, the Federal Reserve implemented a twin-track risk reduction program. First, it encouraged the New York Clearing House, the private sector operator of CHIPS, to impose caps on net debit positions and institute legally binding loss sharing arrangements--backed by a pool of collateral. Second, the Fed began to impose caps and charge fees for daylight overdrafts on Fedwire. In European countries, the search for ways of reducing settlement risk has generally led to plans to introduce real-time gross settlement with full collateralization of daylight overdrafts,

1/ In Table 1, we list the large-value payment systems in the major industrial countries. France (SAGITTAIRE), Germany (EAF), Italy (SIPS), 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.

2/ The U.S. Federal Reserve grants daylight credit to Fedwire participants, and the Bank of Japan stands ready to ensure settlement on Zengin. The systems for foreign exchange transfers in these countries, CHIPS and FEYCS 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, e.g. SIC in Switzerland, there is no need for separating foreign participants for the purpose of segregating risks.

3/ See for example, Richards (1995).

4/ See Humphrey (1986) for the crystallizing study.

instead of just charging fees for them. At the moment, most payments are settled at discrete intervals at the end of the day. 1/

1. Classification of settlement arrangements for wholesale payments

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 first solution can be achieved via net sender caps and loss-sharing agreements in legally certain netting systems. The second solution to reduce settlement risk is to shorten the settlement lag by more frequent settlements during the day or, at the extreme, by immediate settlement of each payment, i.e., real-time gross settlement.

It is useful, therefore, to classify payment systems according to the length of the lag between initiation of a payment and its settlement by the delivery of central bank funds. In discrete-time or net settlement systems, such finality is typically not achieved before the end of the day. To obtain earlier and intraday finality for part of the payments, net settlement can be done more frequently during the day. Immediate finality is obtained in continuous-time or real-time gross settlement systems. But if settlement funds are not available on such systems, payments are rejected or put in a queuing batch until sufficient funds are raised. Consequently, there will be a time lag between originating and settling these payments.

Discrete-time payment systems with end-of-day settlement currently dominate in the industrial countries with the exception of the United States and Switzerland as shown in Tables 1 and 2. In the United States, 54 percent of funds transfers was settled on a net basis and the remaining 46 percent on a gross settlement basis in 1992. Switzerland is the only major country that settles all large-value payments on an RTGS basis. In Japan, a majority of payments is settled on a net basis. 2/ In France and the United Kingdom all payments are settled at the end of the day. Although Germany and Italy introduced a RTGS system in the late 1980s, 86 percent and 89 percent, respectively, of the payment volumes were still settled on a net end-of-day basis in 1992, as shown in Table 2. A similar picture emerges for the smaller European Union (EU) countries, as indicated in Table A1. 3/ Belgium, Greece, Ireland, Luxembourg, Portugal and Spain rely exclusively on end-of-day settlement, while Denmark and the Netherlands

1/ The debate in Europe on risk reduction started in individual countries, but converged to a consensus. See for example Banca d'Italia (1988); Bank of England (1989); Banque de France (1991).

2/ Most interbank payments through BOJ-NET are settled on a net basis at four designated settlement times during the day, while a limited number of payments is settled on a real-time gross basis.

3/ Austria, Finland and Sweden joined the European Union in January 1995. These new entrants are not included in our analysis, because comprehensive data on the payment systems of these countries are not available.

Table 1. Main Large-Value Payment Systems in Selected Countries

Country	Discrete-Time Net Settlement Systems		Continuous-Time Gross Settlement Systems	
	End-of-day	Multiple	Queuing	No Queuing
France				
Paris Clearing House				
SAGITTAIRE	1984			
TBF (planned)			P 1996	
SNP (planned)	P 1996			
Germany				
EAF	1990	→ 1995		
EIL-ZV			1988	
Italy				
SIPS	1989			
Electronic Memoranda	1989			
BISS			P 1996	← 1988
Japan				
Zengin	1973			
FEYSS	1980			
BOJ-NET		1988		1988
Switzerland				
SIC			1987	
United Kingdom				
Town Clearing ^{1/}	1946			
CHAPS	1984	→	1995/6	
United States				
Fedwire				1918
CHIPS	1971			

Source: Bank for International Settlements, Payment Systems in the Group of Ten Countries, Basle, 1993.

Note: P = Planned.

^{1/} Town Clearing ceased operation in February 1995.

Table 2. Daily Payment Flows in Selected Countries

(In billions of U.S. dollars)

Country	1988	1989	1990	1991	1992
France					
Paris Clearing House	77.2	73.1	94.1	85.1	97.0
SAGITTAIRE	8.7	14.3	26.0	31.1	44.7
Banque de France credit transfer system	20.9	20.9	27.2	28.6	32.1
Germany					
EAF (daily electronic clearing)	-	-	61.9	132.3	212.9
Daily local clearing	171.7	221.4	213.3	153.8	142.0
EIL-ZV (intercity credit transfer system)	10.0	14.1	20.7	26.0	34.9
Local credit transfer system	15.3	15.0	20.8	19.6	21.6
Italy					
SIPS	-	5.0	18.8	26.7	38.9
Electronic Memoranda	-	4.2	17.2	20.4	33.9
BISS 1/	4.0	4.3	5.5	5.3	9.3
Japan					
Bill and cheque clearing systems	124.6	129.4	132.4	120.0	112.6
Zengin	39.8	46.3	51.6	52.8	54.5
FEYSS	117.2	147.9	200.4	186.0	196.1
BOJ-NET	692.8	858.8	1,017.9	1,009.9	1,133.8
Switzerland					
SIC	69.0	73.4	87.5	84.8	95.1
United Kingdom					
Town Clearing	54.8	44.3	34.1	15.8	9.8
CHAPS	80.4	96.5	134.9	134.7	147.9
CGO	-	-	-	30.8	48.5
CMO	-	-	-	11.7	14.5
United States					
Fedwire (funds)	640.0	730.4	796.4	769.2	796.8
Fedwire (securities)	367.6	382.8	399.6	465.2	558.8
CHIPS	661.6	760.8	888.4	869.2	953.2

Source: Bank for International Settlements, Payment Systems in the Group of Ten Countries, Basle, 1993.

1/ Including payments between banks and the Banca d'Italia or the Treasury, which are settled across centralized accounts held at the Banca d'Italia.

processed 100 percent and 31 percent of their respective payments on a gross basis in 1992.

In the U.S. 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. 1/ In Japan, electronic funds transfers began in 1973 and became general in the late 1980s. 2/ The major drawback of paper-based payment systems is that risk management is impossible because real-time monitoring--a prerequisite for risk management--is not feasible, as a result all countries are now moving away from paper-based toward electronic payment systems.

Advances in domestic payment systems are frequently accompanied by efforts to improve settlement in money markets. Most industrial countries have implemented major improvements with the adoption of electronic book-entry systems for most government and short-term money market securities. As a result, the cost of trading in securities markets has declined. Moreover, such electronic book-entry systems are crucial for establishing a flexible and cost-effective means of pledging collateral in the newly planned RTGS systems.

1/ The United Kingdom introduced its electronic large-value funds transfer system, CHAPS, in 1984 and by 1995 all payment flows had been shifted from the paper-based Town Clearing to CHAPS. With the introduction of the electronic gross settlement system, SIC, in 1987, some paper-based payments have been phased out in Switzerland. In Germany the majority of payments are settled via its electronic netting system, EAF, which was introduced in 1990. In January 1992, the Bundesbank introduced the Electronic Counter as an electronic means of accessing its express electronic intercity credit transfer system, EIL-ZV (BIS, 1993b). Italy introduced two electronic netting schemes, SIPS and Electronic Memoranda, and one electronic gross settlement scheme, BISS, for large-value payments in 1988-89. At the same time, efforts were undertaken to shift interbank payment flows settled across bilateral correspondent accounts to the new payment networks to promote the daily settlement of payments in central bank money. While domestic large-value payments in France are still settled on a paper basis via the Paris Clearing House, 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. The Banque de France and the French banks intend to dematerialize domestic large-value payments as well.

2/ Electronic payments were introduced initially on the Zengin system, operated by private banks to clear third-party domestic payments, in 1973. The Bank of Japan initiated on-line transfers on its BOJ-NET in 1988. The Tokyo Bankers Association's Foreign Exchange Yen Clearing System (FEYCS) began clearing and settling electronically through BOJ-NET in 1989.

2. 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 go toward an RTGS system has been made, the size of permissible overdrafts, the rate of charges for overdrafts, and the type of collateralization has to be set by the central bank. For example, while Japan, Switzerland and the United States have already implemented an RTGS system, the United Kingdom and France are planning to introduce RTGS with fully collateralized overdrafts.

Commercial banks in the United Kingdom have, in concert with the Bank of England, adopted an evolutionary approach to convert CHAPS to RTGS in 1995-96. ^{1/} As a short-term measure, CHAPS banks implemented bilateral receiver caps to contain intraday credit exposures. Since March 1993, U.K. banks have been experimenting with multilateral or net sender limits. The objective is to reduce voluntarily the net sender limits to 25 percent of the sum of the bilateral limits by September 1994, and a further reduction is foreseen after this 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. The introduction of bilateral and multilateral limits has not caused any major transitional problems so far. CHAPS banks have responded by rescheduling the input of payment messages to reduce imbalances between in- and outgoing payments. Nevertheless, because most payments are originated by customers, banks are to some extent constrained in their ability to reschedule payment flows.

In contrast, France is to switch from paper-based netting procedures to an electronic RTGS system, TBF. Because real-time monitoring is not possible in such paper-based payment systems, banks are unaware of how their net debit positions vary during the day. In addition, French banks have so far 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. ^{2/} 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 called SNP that will meet the Lamfalussy standards to save on collateral holdings. This system will run in parallel to TBF, which will be implemented by the Banque de France in 1996.

Germany upgraded its gross settlement system (EIL-ZV) in 1988, and Italy introduced a gross settlement system (BISS) in 1989. In both countries, however, only a relatively small amount of all large-value payments is settled across these gross settlement systems. The Bundesbank in consultation with the German banking sector has decided to reduce risk in

^{1/} See Bank of England (1993).

^{2/} 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 has decided to require full collateralization of overdrafts in TBF.

its electronic net settlement system (EAF), rather than to encourage a shift from net settlement to RTGS. 1/ The main rationale for preserving and improving the netting system for large-value payments is to reduce the need for reserves. In addition, the present gross settlement system (EIL-ZV) would not be technically flexible enough to cope with the volumes to be processed. 2/

The proposed improvements in risk management for EAF are two-fold. 3/ First, the Bundesbank increasingly requires banks to pledge collateral, which together with bank reserve balances, is used as cover for net debit positions. Since March 1994, the collateral requirement has been based on the highest net debit position of the preceding month rather than on actual net debit positions. Second, the settlement process will be speeded up. As many payments as possible will be bilaterally netted 4/ 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 it is prepared to advance to other banks in this bilateral settlement procedure. To provide cover for these bilateral limits, reserve balances and/or collateral of the sending bank 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 first in, first out (fifo) basis. Remaining payments will be multilaterally netted 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. 5/ However, there will be no penalty or differentiated fee structure to discourage banks from relying on the end-of-day multilateral netting procedure. It remains, therefore, to be seen how much intraday liquidity banks are prepared to preserve for the bilateral settlement cycles in order to achieve early finality.

Italy is planning a drastic overhaul of its present RTGS system (BISS) 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 BIREL, the acronym for the

1/ See Hartmann (1994).

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

3/ See Hartmann (1994).

4/ To reduce risk it is crucial that such bilateral netting has 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, e.g., the failure of Bankhaus Herstatt in 1974.

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

revised RTGS system. 1/ While the present cover principle will be maintained, BIREL will incorporate a more flexible supply of intraday liquidity and a queuing mechanism. First, the Banca d'Italia will grant daylight overdrafts on a collateralized basis. Moreover, the range of securities eligible as collateral may be widened in the future. Second, it is foreseen that banks will be allowed to make full use of their reserves intraday. At the moment, the 'monetary' reserve requirement amounts to 15 percent of deposits, as indicated in Table 6, of which only 8 percent can be used by banks for payment purposes, while the remaining 9.5 percent is frozen during the day. It is planned that the current netting systems for large-value payments (SIPS and Electronic Memoranda) will be gradually phased out.

Turning to the other European Union countries summarized in Table A1, Denmark has processed most of its large-value payments on an RTGS basis since 1981. Danmarks Nationalbank grants daylight overdrafts without cover to the participating banks up to 100 percent of a bank's own funds. Danmarks Nationalbank, however, is currently considering the introduction of a collateral requirement for daylight overdrafts. In the Netherlands, the Central Bank System is a mixed system in which some payments called irrevocable payments are settled in real-time provided that sufficient cover is available, while other 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. 2/ Belgium, Ireland, Greece, Portugal, and Spain also have plans to introduce RTGS systems by 1996, but there are currently no plans for RTGS in Luxembourg. 3/

3. 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. An important issue in the design of queuing mechanisms is whether receiving banks have access to information on pending incoming payments. 4/ If receiving banks have access to this information, 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 uncollected 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, there is the risk of a liquidity shortfall, insofar as banks rely on queued payments for

1/ See Banca d'Italia (1994).

2/ See BIS (1993b). The 8007 System, a net settlement system for international payments, was taken over by the Nederlandsche Bank in 1993. These international payments will eventually also be routed through the Central Bank System after it has been revised.

3/ See Committee of EC Central Bank Governors (1993).

4/ See for example Angelini (1994).

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 RTGS. 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 started operating in 1987. 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 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. 1/ Nevertheless, Swiss banks rely heavily on queued incoming payments as cover for queued outgoing payments, thereby creating a substantial liquidity risk. To illustrate this point, on average in 1993 only 51 percent of the payment volume was settled by 2:00 p.m., while 95 percent of the payment volume was initiated by that time. 2/

The Bank of England intends to deny CHAPS settlement banks access to information on queued payments to avoid liquidity and credit risks. 3/ German banks participating in EIL-ZV also lack access to such information, but a discussion about continuing the policy is currently underway. The proposed arrangements for queuing in France's TBF are also under discussion. The Banca d'Italia is proposing to give receiving banks access to information on queued payments as in SIC. 4/

Another important feature of queuing facilities is the processing sequence. While all five systems will use a first-in, first-out rule, most countries also have a priority code for certain time-critical payments, such as the results from domestic retail clearing or delivery-versus-payment (DVP) transactions. 5/ 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 a crucial element for the establishment of a real-time DVP link between SIC and SECOM, 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. Only the United Kingdom will not incorporate the priority option. Although the

1/ SIC payment flows on a US public holiday are around 10 percent of payment flows on a normal day. See BIS (1993b). While the SIC system closes at 3 p.m. local time for same day value payments, the dollar leg of \$-Sw F transactions is usually routed via CHIPS, which settles at 6 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.

2/ See Vital (1994).

3/ This does not prevent banks from phoning each other to find out whether any payments are pending in the queue.

4/ See Banca d'Italia (1994).

5/ See Section IV.5 below for a more detailed discussion of DVP.

prime responsibility for managing any queued payments will rest with the individual banks, a processing or optimization facility will be operated by the Bank of England to allow simultaneous settlement of queued payments on a net basis. 1/

4. Settlement of foreign exchange transactions

Foreign exchange markets are the deepest and most liquid financial markets, indeed, they are the only truly global markets. Forex markets are decentralized and a significant part of forex trading is carried out between dealers. The settlement of forex transactions raises significant systemic risk concerns, owing to the relatively large daily volumes involved. Global turnover in forex markets mounted to almost US\$ 1.23 trillion per business day in April 1995 according to the fourth triennial survey conducted by the BIS, as shown in Table 3. The two legs of foreign exchange transactions have to be settled in the national payment systems of the two respective currencies. Table 4 indicates that the volume of payment transactions related to forex trade is substantial. In the case of the United States, for example, international transactions amount to more than a third of total transactions. 2/ 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 FEYCS in Japan, are mainly concerned with the settlement of foreign exchange transactions.

The main risk in the settlement of forex transactions is that one party settles its part, while the other party fails to do so. This is the so-called Herstatt risk. In 1974, Bankhaus Herstatt, a small German bank active in the forex market, went into liquidation after the European leg of its forex trades was irrevocably settled, but before the dollar leg was settled through CHIPS. Herstatt or cross-currency settlement risk is largely caused by non-overlapping operating hours of the major payment systems, which in turn is due to differences in the time zones in which the major central banks are located. Hence the simultaneous settlement of the two currency legs is delayed. Another problem is lack of intraday finality in some payment systems. Even if payment systems have overlapping opening hours, simultaneous settlement is not achieved when one of the systems does not settle in good funds before the end of the day. The current payment system reforms are aimed at improving intraday finality either by moving to real-time gross settlement or by implementing the Lamfalussy standards for netting schemes.

1/ See Bank of England (1994).

2/ Although the figures reported in both Tables 3 and 4 refer to 1992, there are some differences for a variety of reasons. First, not all foreign exchange transactions are captured in Table 3 on forex turnover. Next, not all forex trades lead to settlement through national payment systems as reported in Table 4--some parties net their transactions on a bilateral or multilateral basis before settlement, while some transactions, such as currency options, are not always settled in full.

Table 3. Average Daily Gross Foreign Exchange Turnover,
April 1992 and April 1995 ^{1/}

(In billions of U.S. dollars)

	April 1992		April 1995	
	Daily turnover	Percent of total	Daily turnover	Percent of total
U.S. dollar	672.4	82	1,020.9	83
Japanese yen	188.6	23	295.2	24
Deutsche mark	328.0	40	455.1	37
French franc	32.8	4	98.4	8
Italian lira
Pound sterling	114.8	14	123.0	10
Swiss franc	73.8	9	86.1	7
Other currencies	229.6	28	381.3	31
All currencies	1,640.0	200	2,460.0	200

Source: Bank for International Settlements, "Central Bank Survey of Foreign Exchange Market Activity in April 1995: Preliminary Global Findings" (Press Communiqué, Basle: Bank for International Settlements, October 24, 1995).

^{1/} The actual turnover was \$820 billion in April 1992 and \$1,230 billion in April 1995 as two currencies are involved in each transaction.

Finally, private sector settlement practices can contribute to Herstatt risk. In a recent survey of industry practices, it was found that back-office procedures had not kept pace with the rapid changes in the forex markets. 1/ Payment instructions are often 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 the payment 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. Banks can thus continue to trade with a counterparty for one or more days before finding out that this counterparty did not deliver on its past obligations. Improvements in back-office procedures to shorten the time interval between originating and receiving payments can substantially reduce settlement exposures.

The Noël Report explores different institutional approaches to reduce or eliminate Herstatt risk. 2/ One of the options is to extend the operating hours of domestic payment systems. The Bank of Japan recently extended the operating hours for BOJ-NET by two hours until 5:00 p.m. Tokyo time, while the Federal Reserve has announced that it will expand Fedwire operating hours by opening eight hours earlier at 12:30 a.m. EST from late 1997. In combination, the overlap of the Japanese and U.S. settlement periods will then be two and a half hours, given a 14 hour time difference. Moreover, Fedwire will be open throughout the European business day. But extension of opening hours is not sufficient in itself. Linkages between real-time gross settlement systems have to be established to achieve simultaneous settlement or payment-versus-payment (PVP). Such linking of RTGS systems is, however, not without problems. First, access to cash via the central bank and/or the money market need to overlap to obtain PVP, because banks need a mechanism for raising additional funds when they are confronted with unexpectedly large payment outflows. Second, liquidity shocks could easily be 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. 3/

An alternative route to reduce Herstatt risk is to employ multi-currency netting schemes. Examples of such multilateral netting schemes are ECHO in London and Multinet in Chicago. ECHO started its operations in 1995, while it is expected that Multinet will go live in 1996. Estimates indicate that multilateral netting can reduce settlement volume by 75 percent on average. 4/ This also generates substantial savings in settlement costs. However, the settlement of the net amounts is still

1/ See New York Foreign Exchange Committee (1994).

2/ See Committee on Payment and Settlement Systems of the Central Banks of the Group of Ten countries (1993a).

3/ For example, suppose that dollars due for delivery in New York are not settled because of a failure to settle in Tokyo. This may create a problem in the dollar settlement system as the recipient must scramble for funds to cover outgoing dollar payments.

4/ See Glass (1994).

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 amount can be considerable, even after netting. It is estimated that the largest single payment can amount to about \$1.5 billion for ECHO and Multinet. ^{1/}

A first option to cover the largest single payment 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 they may already be closed, it is unclear whether such borrowing can be obtained when needed at short notice. A second option is to collateralize the largest possible net payment obligation in full in advance. ECHO maintains, for example, U.S. Treasury securities with some New York money center banks. These securities can be used as collateral for emergency lending to cover a settlement shortfall. If the settlement shortfall is in another currency than the U.S. dollar, the proceeds can be converted to that currency via a foreign exchange swap. It is clear that the extra cost of maintaining such a large pool of collateral is considerable. Finally, a third option is to arrange a simultaneous exchange of the currencies via PVP. If a participant fails to deliver one of the currencies by a set time, the other currencies can be withheld until the first payment is made. The withheld currencies can be used as collateral to support any borrowing by the clearing house to cover its payment obligations in the currency in which there was a fail.

5. Delivery versus payment

RTGS without uncovered daylight overdrafts reduces settlement risk both of domestic payments and of securities and international transactions, which constitute a sizeable part of large-value funds transfers, as reported in Table 4. The main risk in securities, as in foreign exchange transactions, is that one party settles 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 (1989) recommended delivery-versus-payment (DVP) 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. A link between an RTGS system and a real-time book-entry securities settlement system enables parties to achieve DVP on a trade-by-trade basis.

The U.S. Fedwire book-entry system for the transfer of U.S. government securities is an example of such a system that allows for the immediate and simultaneous transfer of securities and central bank money. DVP for Japanese government bonds was introduced on BOJ-NET in April 1994 with a linkage of the funds transfer and book-entry systems. Switzerland linked its SECOM system with SIC to provide for DVP on a trade-by-trade basis in 1995. Once the conversion of CHAPS to RTGS is completed, the United Kingdom will

^{1/} See Duncan (1994) and Glass (1994).

Table 4. Break-down of Daily Payment Flows 1/

Country	1992	percent of total	
(In billions of U.S. dollars)			
France			
Daily payment flow	201.5	100.0	
International transactions	44.7	22.2	
Securities transactions	27.7	13.7	
Treasury bills <u>2/</u>		7.7	3.8
Other debt securities < 7 yrs		0.4	0.2
Government bonds		8.6	4.3
Other bonds and equities		11.0	5.5
Other transactions	129.1	64.1	
Germany			
Daily payment flow	423.4	100.0	
International transactions	206.5 <u>3/</u>	48.8	
Securities transactions	12.0	2.8	
Other transactions	204.9	48.4	
Italy			
Daily payment flow	96.7	100.0	
International transactions	38.9	40.2	
Securities transactions	14.6	15.1	
Government securities		14.2	14.7
Bonds and equities		0.4	4.1
Other transactions	43.2	44.7	
Japan			
Daily payment flow	1,497.0	100.0	
International transactions	196.1	13.1	
Securities transactions	112.9	7.5	
Treasury bills		32.7	2.2
Financing bills		22.5	1.5
Japanese government bonds		47.6	3.2
Agency and corporate bonds		5.0	0.3
Equities		5.1	0.3
Other transactions	1,188.0	79.4	
Switzerland			
Daily payment flow	95.1	100.0	
International transactions	85.6 <u>4/</u>	90.0	
Securities transactions	1.1	1.2	
Other transactions	8.4	8.8	

Table 4 (continued).

Country	1992	percent of total	
(In billions of U.S. dollars)			
United Kingdom			
Daily payment flow	220.7	100.0	
International transactions	74.0	33.5	
Securities transactions	64.5	29.2	
Gilts		48.5	22.0
Money market instruments		14.5	6.6
Equities		1.5	0.7
Other transactions	82.2	37.2	
United States 5/			
Daily payment flow	2,308.8	100.0	
International transactions	865.1	37.5	
Forex transactions		526.5	22.8
Eurodollar transactions		338.6	14.7
Securities transactions	793.6	34.4	
Government securities		558.8	24.2
Other securities		234.8	10.2
Other transactions	650.0	28.2	
Fed funds		270.7	11.7
Commercial and miscellaneous		379.3	16.4

Sources: Bank for International Settlements, Payment Systems in the Group of Ten Countries, Basle, 1993; European Monetary Institute, Blue Book Addendum, Basle, 1994; Bank of England, Quarterly Bulletin, November 1992; Federal Reserve Bank of New York, Quarterly Review, Winter 1987-88; Central Banks.

1/ The breakdown of payment flows in international, securities and other transactions should be interpreted with caution, because these 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.

2/ These figures do not include repurchase agreements involving Treasury bills.

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

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

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

also develop a mechanism to provide real-time DVP for the settlement of gilts in the Central Gilts 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. 1/ 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. 2/ Nevertheless, once the RTGS systems become fully operational and are more actively used, further measures will likely be taken to strengthen DVP linkages in these countries.

IV. The Background of Payment System Policy

The payments-related reform efforts underway in the major industrial countries are motivated by: (1) the systemic risk inherent in discrete-time net settlement arrangements, and in particular the recognition that the central bank would be obliged to intervene to avoid systemic disruption should a serious failure occur; and (2) the growing credit-risk exposure of the central bank 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 the banks to internalize the cost of third party risk. 3/

1. Controlling payment system risk in the United States

In the United States, controlling risk on the RTGS system has taken two principal forms--placing caps on the amount of uncollateralized overdrafts and pricing the overdrafts. 4/ 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 in March 1986. These caps were stated as multiples of bank capital; and in succeeding years, the permissible multiples by which overdrafts may 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, the 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. 5/

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 loss sharing

1/ See Bank of England (1994).

2/ See BIS (1992) and (1993b).

3/ See Passacantando (1991).

4/ See Board of Governors of the Federal Reserve System (1995).

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

backed up by collateralization arrangements in 1990. The loss sharing arrangement specifies that each surviving bank shares in the losses proportional to its share in the sum of bilateral caps 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 have an incentive to monitor the creditworthiness of other banks and to intervene by reducing their bilateral caps. 1/ However, 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, a further program of risk reduction was launched in which a 20 percent reduction in net debit caps was scheduled to be implemented by January 1997, at the same time an increase in the minimum amount of collateral was imposed. 2/

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. 3/ Excessive violation of the overdraft caps triggers a regulatory response of varying severity, possibly leading to a rejection of further payments that generate the overdrafts. 4/ Despite the efforts to control overdrafts through caps, the amount of overdrafts increased from a typical peak daily overdraft of \$60 billion in 1986 to overdrafts in excess of \$120 billion in 1993, with the growth mostly 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 category.

After several years of discussion, the Federal Reserve announced in 1992 a program to impose charges for overdrafts beyond a permissible allowance, to begin in April 1994. The initial charge was ten basis points at an annualized rate on average overdrafts during the day beyond a certain allowance. 5/ Peak overdrafts immediately fell on average by 40 percent--from nearly \$125 billion to about \$70 billion--, with securities-related overdrafts falling by 45 percent and funds-related overdrafts falling by 25 percent. Thus, the imposition of a fee had a more dramatic impact on overdrafts than the caps. Caps tend to be the constraining factor in most institutions, which tend to pay very small overdraft fees. For larger

1/ See Garber and Weisbrod (1992) and Schoenmaker (1995) for an extensive analysis of risk management in CHIPS.

2/ See Richards (1995).

3/ For payments overdrafts related to book entry securities transactions, banks may present collateral as cover--such covered overdrafts are excluded from the overdrafts to which the cap applies.

4/ The monitoring system also has the capability of either rejecting a payment and removing it from the system or queuing the payment until sufficient funds are received into the paying bank's account.

5/ 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. See section VI.2 for a more detailed discussion of the impact of these charges.

institutions, the 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 have 70 percent of the overdrafts. 1/ A subsequent rise in the fee to fifteen basis points in April 1995 did not have much 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. 2/

2. Choice for real-time gross settlement in Europe

The major European Union countries have, in the context of discussing the future monetary system in Europe, declared their strong support for adopting real-time gross settlement systems for wholesale payments in Europe. There are three reasons behind this choice.

First, the fast growing volume of payment flows 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 altogether from the payment system. 3/ Other central banks--for example the Banque de France and the Deutsche Bundesbank--take an intermediate position by requiring RTGS for certain time critical payments and allowing net settlement for the remaining large-value payments. 4/ 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. However, because payments generated by the sending bank's customers--which are outside the control of the receiving and sending bank--exceeding the bilateral cap will be blocked, bilateral caps will also have to take into account the payment traffic between the two banks to avoid significant settlement delays. 5/ A minimum level of interbank credit is required for the smooth running of a

1/ See Richards (1995), p. 1072. See also Hancock and Wilcox (1995) on the relative unimportance of caps.

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

3/ See for example Bank of England (1993).

4/ See Hartmann (1994), BIS (1993b).

5/ 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, which 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. However, a heavy use of such re-routing techniques would defeat the efficiency of netting systems.

net settlement system. There is thus a fundamental conflict between prudential and operational needs.

Second, the legal status of netting is not beyond doubt in all countries. This problem is amplified 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. That is far from clear at present. Although payments settled through gross settlement systems can also be challenged by a liquidator, 1/ the legal risk is manageable as payments from the liquidated bank may be identified and revoked, but other payments which are already settled will not be affected and the whole settlement process will thus not be undone at once.

Third, the introduction of RTGS will allow for real-time DVP and hence reduce, if not eliminate, settlement risk in securities transactions. While most European countries have, or are planning to introduce, real-time book-entry systems for the transfer of securities in place, RTGS systems are needed to ensure the real-time transfer of funds.

While these arguments have led most European countries toward RTGS systems, one of the exceptions may be Germany, which is currently implementing measures to reduce risk in its main netting system, EAF. It can be argued, however, that the scheduled improvements of EAF (20-minute settlement cycles and collateralization of net debit positions on an ex-post basis) will bring EAF 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, with a large number of small banks, 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.

3. 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 was added to the debate on risk-reduction in Europe. In January 1991, the then Committee of EC Central Bank Governors created an 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 explores the possible linking of payment systems in stage 3 of Economic and Monetary Union (EMU). 2/ The move toward RTGS was reinforced by the Working Group in one of the principles laid down in the report: "As soon as

1/ An example of legal risk in net and gross settlement systems is the zero-hour clause in some EU countries, e.g., Italy and the Netherlands. The bankruptcy laws in these countries may retro-actively delete transactions of a closed institution after 0.00 a.m. on the day it is ordered to be closed. See Committee of EC Central Bank Governors (1992a).

2/ Committee of EC Central Bank Governors (1993).

feasible, every member state should have a real-time gross settlement system into which as many large-value payments as possible should be channelled."

With the start of Stage 2 of EMU in January 1994, the European Monetary Institute (EMI) took over from the Committee of EC Central Bank Governors. In May 1995, the EMI published a blueprint of the new payment system for the single currency. ^{1/} 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 must have an RTGS system before it can join EMU. Banks can continue to keep their settlement accounts at the NCBs and the role of the ECB will be limited.

The EMI proposes minimum harmonization for payment system features in the early stage. Aspects that affect the implementation of a single monetary policy, such as the provision of liquidity, will be harmonized. But there will be no harmonization of queuing procedures in the individual country payment systems. This may be problematic, 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. The RTGS systems with queuing may thus be draining liquidity from other, more liquid systems. ^{2/}

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 can 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 routed via the interlinking of national systems will be exclusively denominated in the European currency. To create an open system, non-EMU members have the option to link their RTGS system to TARGET provided that these non-EMU central banks convert payments from the national currency into the European currency before they are transmitted.

4. Co-existence of net and gross settlement

A final, unresolved policy issue is the co-existence of net and gross settlement systems at the national level. While netting arrangements may contribute to a less costly liquidity management for commercial banks, gross settlement systems operated by the central bank are usually the means for such netting schemes to achieve final settlement at the end of the business day. The United States has long standing experience with netting and RTGS operating side by side. To avoid competitive distortions, the Federal

^{1/} See EMI (1995).

^{2/} More generally, payment-versus-payment mechanisms linking payment systems from different countries to eliminate Herstatt risk are also vulnerable to this externality. See section III.4 for a discussion of international payments.

Reserve adopted a twin-track approach to control payment system risk, as discussed above. Ahead of the introduction of charges for daylight overdrafts on Fedwire, multilateral caps and loss-sharing were imposed in CHIPS. Early evidence confirms that there has been little or no migration of payment volume from Fedwire to CHIPS so far, in response to the daylight overdraft fees. 1/ In contrast, although European central banks have repeatedly expressed their desire to implement RTGS commercial banks may still have a preference for net settlement, as netting reduces significantly the need for liquidity. 2/ As discussed in section II.2, French banks are developing a net settlement system, SNP, which should run in parallel with the RTGS system, TBF, and Germany decided to strengthen and preserve its netting system, EAF. In Japan, the wholesale payment systems are almost entirely netting systems. The one exception is BOJ-NET, in which banks can elect to settle on an RTGS basis. 3/ They can also 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. 4/

Research comparing the cost of net and gross settlement indicates that the cost of extra liquidity holdings in RTGS could under certain circumstances exceed the benefits of the obtained reduction in settlement and systemic risk. 5/ According to the proposals for RTGS in Europe, banks must collateralize fully any daylight overdrafts to eliminate settlement and systemic risk. The opportunity cost of tying up securities as collateral is estimated to be around 25 basis points. Thus, 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 such netting 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 found to be moderate. The aggregate cost of settlement failures in netting systems appears to be about half the aggregate cost of collateral holdings in RTGS. 6/ Analysis of different scenarios for the resolution of settlement failures does not significantly alter the results. Netting systems are thus the lowest cost alternative.

But how can this result be reconciled with the European central banks' preference for RTGS over net settlement? An important assumption of the analysis is that both the central bank and commercial banks are risk-neutral, which explains the relatively low cost of settlement failure. Repeating the calculations with a risk-averse central bank may shift the balance from net settlement to RTGS.

1/ See Richards (1995) and Horii and Summers (1994).

2/ See Committee of EC Central Bank Governors (1992a), (1993) and EMI (1995).

3/ See BIS (1993), p. 267.

4/ See Anzai, (1996).

5/ See Schoenmaker (1995).

6/ See Schoenmaker (1995). It should be noted that potential further risk-reductions in RTGS systems via DVP-mechanisms are not included in this estimation.

Alternatively, a central bank may wish to reduce its role as lender of last resort in the payment system to strengthen market discipline. The lack of supervisory powers for a prospective European Central Bank suggests that a minimal lender of last resort role is foreseen for the European Central Bank. 1/ The obvious way to obtain such minimal intervention is to link domestic RTGS systems without daylight credit exposures. If safer and more expensive payment systems lead to less banking regulation and supervision, the balance between netting and RTGS is not clear-cut. The potential benefits from a more permissive and less distortionary regulatory system could outweigh the extra cost of RTGS. 2/

V. Payment Reform and the Availability and Cost of Intraday Liquidity

A common principle underlying the introduction of RTGS in Europe is a strict adherence to the principle that there be no extensions of uncovered daylight credit to the participating banks. 3/ Banks must have reserves or collateral at the central bank before they can make payments. If settlement funds in the form of reserves or collateral are not available, a bank will have to delay its outgoing payments until it has received incoming payments or raised fresh funds. Delay of settlement by one bank may lead to further settlement delays by other banks due to a lack of incoming funds from that bank, and eventually to a standstill or gridlock of the payments flow. 4/ Furthermore, frequent and long settlement delays would defeat the purpose of the introduction of RTGS, namely direct finality of payments. A certain amount of intraday liquidity is crucial for the smooth running of an RTGS system.

Table 5 shows the available sources of intraday liquidity in our sample of countries. In all countries, banks are, or will be, allowed to use their reserves for settlement purposes during the day. In addition, central banks in France, Germany, Italy, the United Kingdom and the United States grant, or will grant, daylight overdrafts to banks participating in the RTGS system. In the U.S., the Federal Reserve has adopted a system of charging for such daylight overdrafts, while the European central banks will implement a collateral requirement for daylight overdrafts. 5/

1/ See Folkerts-Landau and Garber (1992).

2/ See Schoenmaker (1995).

3/ Danmarks Nationalbank currently provides uncovered daylight credit in its RTGS system, but it is considering the implementation of a collateral requirement.

4/ See Angelini (1994), and Schoenmaker (1994).

5/ The Federal Reserve started to charge an explicit intra-day fee of ten basis points for banks' average daylight overdrafts in April 1994, which was subsequently increased to fifteen basis points in April 1995. Early experience with fees for daylight overdrafts on Fedwire indicates a steep decline in the use of daylight overdrafts. As discussed in section III.1, peak overdrafts fell on average by 40 percent after the introduction of the ten basis points fee, but there was no significant decline after the increase to fifteen basis points.

Table 5. Intraday Liquidity in Selected RTGS Systems

Country	CB daylight overdrafts	Collateral requirement	Intraday use of reserves
France			
TBF (planned)	yes	full	full <u>1/</u>
Germany			
EIL-ZV	yes	full	full
Italy			
BIREL (planned)	yes	full	full <u>2/</u>
Japan			
BOJ-NET	no	-	full
Switzerland			
SIC	no	-	full
United Kingdom			
CHAPS	yes	full	full <u>3/</u>
United States			
Fedwire	yes	no <u>4/</u>	full

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

2/ With the introduction of BIREL in 1996, the Banca d'Italia is considering allowing banks to make full use of their reserves intraday. At the moment, banks are only allowed to use part of their reserves for intraday settlement purposes.

3/ 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.

4/ Although banks are not 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.

The introduction of RTGS based on the cover principle will demand active liquidity management by banks and may require a more frequent injection of reserves by the central bank during the day to avoid a build-up of intraday liquidity shortfalls. At the moment, central banks generally aim to eliminate liquidity shortages in the course of the day to enable banks to square their end-of-day position or to meet reserve requirements imposed on them. 1/ A general liquidity shortage in the money market during the day could cause settlement delays.

To illustrate this point, 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 there is a shortage in the money market of say \$4 billion during the day, the payment system will effectively have to operate on \$6 billion of intraday liquidity rather than the \$10 billion provided by the banks, and this can severely delay the settlement of payments. Central banks will thus have to relieve shortages caused by payments to the Treasury or currency flows almost instantaneously to avoid settlement delays in an RTGS environment, unless banks top up their eligible paper holdings to avoid the problem on average. 2/

Moreover, a well-functioning daylight interbank market is needed to redistribute reserves from surplus banks to deficit banks: even if the central bank relieves the shortage and injects \$4 billion of reserves into the money market, a mechanism such as the interbank market will be needed to channel funds to banks that need them to make payments. 3/

1. Reserve balances

Reserves held at the central bank are maintained by banks either under a binding monetary reserve requirement imposed by the central bank or as a voluntary clearing balance. During the last decade, there has been a global trend to lower binding reserve requirements to avoid distortions--notably disintermediation and de-localization--created by such requirements. 4/ Will future reserve holdings, whether required or voluntary, provide sufficient intraday liquidity to support RTGS systems? Whether there is sufficient liquidity depends mainly on the amount of reserves held and the

1/ For example, when repurchase agreements or bills obtained by the 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. A reserve shortage therefore exists from the time that the old operations mature until the time that the new operations are executed.

2/ The need for active central bank intervention to relieve money market shortages may be less pressing when sufficiently large back-up facilities, such as unused Lombard credit (see below), are available.

3/ 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.

4/ See Kasman (1992).

payment volume in a particular country. 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. 1/

Table 6 summarizes the current level of reserve requirements in our sample of countries. 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 0.8. Germany also has a relatively low turnover of reserves, 7.8. While France has a medium position with a turnover ratio of 37.8, Japan, Switzerland, the United Kingdom and the United States have high turnover ratios ranging from 65 to 100.

While current reserve requirements differ significantly across the European countries, they will have to be harmonized as part of a common monetary policy in Stage III of EMU. The EMI has not yet decided on the need for a reserve requirement as an instrument of monetary policy, nor on the appropriate size of such a requirement. 2/ Once a common reserve requirement is implemented, however, banks would likely be allowed to use reserves intraday for settlement purposes.

Reserve requirements are usually regarded as a tax on the banking sector, as reserves typically yield zero or below market interest rates. 3/ Of the central banks listed in Table 6, 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.

2. Range of securities eligible as collateral

As a second source of intraday liquidity in the newly designed RTGS systems, central banks will provide collateralized daylight overdrafts. The

1/ This relationship will be positive, though non-linear. For example, it might follow the square-root relationship of a simple inventory model.

2/ A full discussion of the issue 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 (1994a). Some of the other European central banks may see less a need for reserve requirements, however.

3/ The tax argument is based on the assumption that requirements are binding. In general, however, banks want reserves. For example, the daily turnovers of bank deposits at the Bank of England and the Federal Reserve are similar. Nevertheless, reserve requirements in the U.K. minimal, while they are much higher in the U.S. Apparently, banks in the U.S. 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 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.

Table 6. Reserve Requirements in Selected Countries

Country	Percentage of deposits	Reserve balances at central bank <u>1/</u> (1994 figures)	Daily turnover of reserves <u>2/</u> (1992 figures)
		(In billions of U.S. dollars)	
France	1 percent for sight deposits 1 percent for savings deposits 0.5 percent for time deposits	3.4 (5.4) <u>3/</u>	37.3
Germany	5 percent for sight deposits 2 percent for savings deposits 2 percent for time deposits	26.3 (54.6)	7.8
Italy	17.5 percent for all deposits	67.7 (105.4)	0.8
Japan	0.05 to 1.3 percent for sight and savings deposits	29.7 (22.8)	65.7
Switzerland	2.5 percent for short-term deposits	1.5 (1.4)	67.9
United Kingdom	0.35 percent for deposits <u>4/</u>	2.2 (2.2)	100.3
United States	3-10 percent for sight deposits <u>5/</u> 0 percent for savings deposits 0 percent for time deposits	27.4 (25.4) <u>6/</u> (33.1) (30.6)	90.9 75.5

Sources: Banque de France, Bulletin Trimestriel, December 1993; Deutsche Bundesbank, Monthly Report, May 1994; Banca d'Italia, Economic Bulletin, February 1994; Bank of Japan, Economic Statistics Monthly, April 1994; Swiss National Bank, Monthly Bulletin, July 1994; Bank of England, Quarterly Bulletin, May 1994; Board of Governors of the Federal Reserve System, Federal Reserve Bulletin, June 1994.

1/ 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.

2/ The turnover of reserves is calculated as the total daily payment volume, including payments related to securities transactions, divided by the amount of reserves.

3/ The figures within brackets refer to 1992.

4/ 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.

5/ 3 percent for sight deposits in banks with deposits from 0 to \$51.9 million and 10 percent for sight deposits in banks of more than \$51.9 million.

6/ Excludes required clearing balances. Data on next line include required clearing balances; these are excess reserve deposits used for clearing balances to avoid overdrafts. They earn a market-based yield that the banks can use to pay for Federal Reserve charges for banking services.

central bank then effectively converts 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. 1/ It is, therefore, no surprise that government securities appear prominently on the list of eligible securities, as reported in Table 7.

While France and Italy restrict, at least initially, the range of eligible securities to government issues, Germany and the United Kingdom also accept other marketable assets as collateral. In Germany, commercial banks are allowed to use unused Lombard loan facilities for payment cover during the day. Lombard loans are granted by the Bundesbank against the pledging of government securities (T-bills, Treasury bonds and Treasury discount paper), bills of exchange and eligible bonds. 2/ The Bank of England will accept U.K. Treasury bills, eligible local authority bills and eligible bank bills as collateral. 3/ This is basically the same range of assets that the Bank is prepared to buy in its daily open market operations. In addition, U.K. gilts denominated in pound sterling and U.K. foreign currency marketable debt will be accepted by the Bank as collateral for daylight overdrafts. 4/

European central banks participating in the European Monetary Institute are exploring possibilities of adding securities issued by foreign governments to those eligible as collateral. Nevertheless, they have not yet considered harmonizing the range of eligible securities, and it is not clear how far a harmonization should proceed. A lack of harmonization can create disadvantages for banks that are headquartered in one EU country and seek access to the payment system in another EU country. Banks typically keep most of their liquid assets in their home country and consequently have only a limited amount of securities available in host countries. This may cause difficulties if they wish to participate in the RTGS system of the host country. A solution currently under discussion among the European central banks is to allow banks to pledge collateral at their home central bank for overdrafts granted by the host central bank. The same solution could be used if European RTGS systems are linked in Stage III of EMU.

1/ 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 giving a haircut on its evaluation of riskier assets.

2/ Eligible bills are backed by three parties 'known to be solvent', i.e. subject to audit, with a maturity of under three months. Bonds that meet certain minimum standards, such as creditworthiness of issuer and marketability, are eligible as collateral. These bonds are typically issued by state or government-related banks.

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

4/ See Bank of England (1994).

Table 7. Securities Eligible as Collateral for Daylight Overdrafts

Country	Securities
France	1 Treasury bills 2 Treasury bonds
Germany	1 Bills of exchange 2 Treasury bills 3 Treasury discount paper 4 Government bonds 5 Eligible bonds (in DM)
Italy	1 Government paper 2 Government-guaranteed paper
United Kingdom	1 U.K. Treasury bills (in £) 2 Eligible local authority bills 3 Eligible bank bills 4 U.K. gilts (in £) 5 U.K. foreign currency marketable debt

Sources: Bank of England, Quarterly Bulletin, May 1994; Central banks.

Electronic book-entry securities settlement systems in conjunction with securities depositories are crucial for a flexible and cost-efficient means of pledging collateral at the central bank. Without such book-entry systems, banks would have physically to move the securities to the central bank. The United Kingdom and France 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 money market instruments and the CGO for the transfer of gilts. France also has two systems for the transfer of securities. The first, operated by the Banque de France, is SATURNE for Treasury bills and other bills, and the second, privately operated, is RELIT for Treasury bonds and other long-term securities. Although most of the collateral will probably be pledged at the start of the business day and returned at the close, the real-time properties of the U.K. and French book-entry systems enable banks to pledge extra collateral or to 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 Kassenverein 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 in the day and repurchase the same securities before the close of business. ^{1/} This is a legally sound way of pledging collateral because the ownership of the securities is transferred from the borrower to the lender.

3. Case studies of the cost and availability of intraday liquidity

Because intraday liquidity balances are costly to maintain, banks have an incentive to economize on their liquidity holdings. Collateral requirements involve an opportunity cost because 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. ^{2/} Moreover, securities eligible as collateral typically trade with a liquidity premium compared to ineligible securities with similar risk characteristics. If the

^{1/} 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.

^{2/} 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 intra-day. Although their book-entry systems can handle such transfers in principle, the question is how much time will be needed and how much it will cost.

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 is also influenced by the stage of development of the financial market. 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.

To illustrate the relationship between the cost and the amount of intraday liquidity, we analyze three different cases. The first, Switzerland, is an example of RTGS that operates only with reserves. In the second case, the United Kingdom, the main source of intraday liquidity will come from collateral holdings. The third case, Germany, involves a combination of high reserve balances and large collateral holdings.

Switzerland

Before the introduction of SIC, the new RTGS system in Switzerland, banks held reserve balances on the order of Sw F8 billion at the Swiss National Bank. The combined effects of introducing SIC and lowering reserve requirements led to a sharp decline in reserve balances. Balances have dropped to about Sw F2 billion. The daily turnover-ratio of reserves is about 60 to 70 times per day on an average day and up to 100 times on peak days. 1/ Swiss banks keep the level of reserves to a minimum by just meeting the low reserve requirement. 2/ Banks prefer to optimize their payment flows and to rely on queuing facilities, rather than acquire additional reserve balances at a cost equal to the short-term interest rate. Examples of mechanisms to optimize payment flows are changing the input sequence of payment orders or splitting large payments. In addition, some large Swiss banks bilaterally net some payments on an informal basis to reduce their payment volume. The heavy reliance on the queuing facility has led to delays in the settlement of payments. 3/ As long as banks face an opportunity cost of the full interest foregone on free reserves, they are not likely to increase their reserve balances. The delays in SIC can, therefore, be expected to continue.

The United Kingdom

In the United Kingdom, CHAPS plans to shift from net settlement to RTGS in 1995-96. During 1994, the daily payment flow on CHAPS averaged about

1/ Vital (1994).

2/ 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. However, the figures vary depending on bank category. The large banks, for example, have reduced their excess liquidity toward zero since the beginning of 1993.

3/ See also the discussion in section III.3, which reports that on average only 51 percent of payment volume was settled by 2:00 p.m., while 95 percent of volume was initiated by that time. See Vital (1994).

£100 billion. Initial estimates indicate that U.K. banks will need about £10 billion of intraday liquidity to guarantee timely settlement of payments under RTGS. The current reserve holdings by banks amount to £1.4 billion, so banks must pledge collateral up to £8.6 billion. As explained above, collateral holdings are costly for banks to maintain. There is some partial evidence that the opportunity cost of collateral amounts to 25 basis points on an annual basis. One of the major categories of securities that can be used as collateral is eligible bank bills. The first type of evidence is to compare 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 to compare 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 also averaged around 25 basis points. 1/ Assuming that the collateral constraint is binding, the total annualized cost of collateral holdings of £8.6 billion would then be £21.5 million. 2/

1/ Schnadt (1994).

2/ The cost is calculated over the incremental amount of securities needed under RTGS. Banks are currently holding certain eligible securities for particular purposes, e.g., for open market operations with the Bank of England or for liquidity management. We 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 next section, we analyze the impact of this extra demand on the liquidity premium for a generic European payments system.

In the case of the U.K., there may 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 £1.5 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. There is no officially published liquidity requirement, but the Bank of England 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 gilts. All these assets can be used as collateral for overdrafts while still satisfying the primary liquidity requirement; so £17.8 billion is already available compared to the £10 billion estimated as necessary for the payment system.

Only if banks use their stock of liquid assets for active liquidity management during the day might there be an incremental demand for securities eligible for collateralizing overdrafts. It may be that the current liquid security holdings are to cover an extreme need for overnight funds in the presence of a liquidity shortage. If such an event indeed occurred, there might be a payments gridlock 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.

Germany

In Germany, banks are required to maintain relatively high reserve balances of DM42 billion. In addition, German banks have lodged about DM440 billion in securities at the Bundesbank. ^{1/} While on average DM140 billion of these securities 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 to the average daily payment flow of DM600 billion in EAF. Furthermore, 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 may change in the future with more active financial markets and rising payment volumes.

VI. The Impact of RTGS on Liquidity of Financial Markets

The United States and the European countries have embarked on two different methods for reducing the risk faced by central bank from RTGS payment systems. ^{2/} The United States Federal Reserve has decided to permit uncollateralized overdrafts, but it levies a charge for the average amount of overdrafts during the day. Various European central banks will permit overdrafts collateralized by eligible paper, but without a finance charge. Thus, the European central banks will eliminate their day-to-day credit risks in operating their RTGS systems, but they will forego revenue from overdrafts. The Federal Reserve will continue to bear credit risk, but it will be partially compensated by the overdraft receipts. ^{3/} Both methods provide incentives to users of the payment system to avoid tapping daylight central bank credit.

Aside from differing in their effect on central bank credit risk, the two methods also will have different impacts on the pricing of money market instruments. Specifically, the Federal Reserve method will tend to increase the yields on Treasury securities relative to non-Treasury securities, while the European method will tend to reduce the yields on Treasury securities and other eligible securities relative to non-Treasury securities. In addition, in the United States, bid-ask spreads on Treasury and other liquid securities should widen more than bid-ask spreads on less liquid securities.

^{1/} Deutsche Bundesbank (1994b).

^{2/} Japan, whose payment systems are almost entirely on a net settlement basis, has not yet embarked on a similar risk control policy, though the Bank of Japan is interested in strengthening its RTGS operation. See Anzai (1996).

^{3/} To complete a commercial bank analogy, the Federal Reserve might wish to hold these added revenues to accumulate a loss reserve sufficient to cover the losses that it perceives it may incur on the payment system through overdrafts. If, instead, it passes the revenue through to the Treasury as profit, it may later require a capital injection from the Treasury if the losses that it fears ever materialize.

In Europe, bid-ask spreads on eligible securities will widen by less than spreads on ineligible securities.

1. Charges for overdrafts

For the intuition behind these results, we first consider the system in the United States. Treasury securities typically are the most liquid 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 it is precisely trades in Treasury securities that generate a large share of the overdrafts in the payment systems. Alternatively stated, the existence of unpriced overdraft facilities in the 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 it is they that generate the largest share of total payment volume. This charge will be passed through to the dealers by the banks, and the dealers 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 the 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 system of charging for overdrafts, 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 the 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, so for the consolidated Treasury-Fed, net revenues from this change are zero, and there is 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. 1/ 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 the overdraft charge reduce overdrafts. 2/ Nevertheless, the overall risk to the Federal Reserve and Treasury from overdraft default probably has been reduced very little by this program. 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. In such conditions, the charges are not a disincentive for a failing bank to fire out payments.

Transactions in private securities will also 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 they are typically less liquid than government paper, the average private security will be traded much less than a government security and so incur the overdraft charge much less frequently. Thus, 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 amounts to a charge of about ten basis points annualized for average overdrafts during business hours. It is difficult to separate the effect of the imposition of charges for payments from other effects on

1/ See Garber and Weisbrod (1990).

2/ Measures of the sort discussed earlier--putting off DVP until late in the day, delaying the closing out of repurchase agreements, moving from the book entry system to net settlement in T-bills--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 to avoid overdraft charges, the increased finance costs of the Treasury will not be offset by increased revenues from the overdraft charge.

interest rates, 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. Nevertheless, 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 the overdraft charges. 1/

2. Collateralization for overdrafts

Next we turn to 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, we will refer to eligible paper as government securities because such securities will probably comprise the bulk of eligible paper, and we will assume that the increased usefulness of such paper in permitting overdrafts will increase bank demand for it. 2/

First, we consider the impact of collateralization on overdrafts incurred by DVP in ineligible securities. For such an overdraft, 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 be charged on a pro-rata basis to those transactions that incur overdrafts. Dealers in ineligible paper must 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 will therefore be relatively small. Also, 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 also 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 is also reduced by the new collateralization

1/ By April 18, 1994, other forces took over: the monetary tightening by the Federal Reserve raised yields by upwards of 20 basis points above the levels of April 13.

2/ It may be that banks already hold a sufficient amount of such paper for liquidity purposes that they would not expand their holdings, as pointed out above in our discussion of the UK and Germany. French credit institutions and mutual funds controlled by them hold a large amount of Treasury bills, but these bills cannot be readily mobilized by the banks from their funds because of regulations that prevent self-dealing.

rules. As the most liquid of the securities, trading in government securities will typically 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 immediately be mobilized for delivery as collateral for further overdrafts. Nevertheless, the costs of the reserve of government securities 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. However, since government securities are generally more liquid than ineligible securities, they generate far more overdrafts on average, so on net we cannot predict which of the bid-ask spreads will increase by more. The decline in yield on government securities will occur so that nonbank holders will release them to the banks, whose demands for them will increase. To hold government securities after their liquidity has been reduced, the public will usually require a higher yield. However, ineligible securities will also become less liquid, so the public may be content to hold the government securities without a higher yield. To reduce the amount of government securities in the hands of the nonbank public and to move them to the banks requires a reduction in yield.

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 the central bank eliminates the credit risk it bears on the system. Unlike the reforms in the United States, where the Treasury and the Fed enhance their revenues to cover the service of bearing credit risk in payment system operation, the collateralization method in Europe enhances treasury revenues, while abandoning in normal situations the provision of the service of bearing credit risk in payment system operations. In a severe situation, like the ERM crisis, however, there may be an insufficiency of collateral to manage the payment traffic. Collateral may have been 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 allow the payment system to seize up. It is in exactly such a situation that we would expect weak institutions to collapse, thereby leaving the central bank with an uncovered loss borne on the payment system. To prepare for this eventuality it may be desirable to use the interest charges to establish a loss reserve.

VII. Conclusion

The growth in the volume of national and cross-border financial transactions during the 1980s 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 cascading across the entire system and of producing payments gridlock that ultimately could have serious consequences for the real economy. This specter has provided the urgency for much of the ongoing reforms.

The objective of these reforms has been to achieve a reduction of the credit risk associated with the growth in intraday credit exposures that arises in net settlement systems and in real-time gross systems when the central bank provides daylight overdrafts. Principally, central banks have sought to reduce intraday payments-related credit in net settlement systems by restructuring these payment system into real-time gross settlement systems with collateralized overdrafts. Furthermore, in the existing real-time gross settlement systems, the risk-abatement program currently in effect has taken the form of placing caps on the size of the uncollateralized daylight credit and of levying charges on such overdrafts.

In evaluating the success of the current efforts to strengthen the world's wholesale payment systems three related issues need to be taken into consideration. First, the reduction in systemic risk, due to the reduction in payments-related intra-day credit exposures, is achieved at a price. In particular, a reduction in payments-related credit reduces liquidity in financial markets, i.e., it increases bid-ask spreads for financial instruments roughly in relation to the share of daylight overdrafts that is due to trading in these instruments. Payment patterns change in order to lower overdrafts, while trading patterns in securities markets can not easily be rearranged. But separating the timing of securities transactions from the timing of payments would only serve to increase settlement risk.

In any event, intraday credit has economic value and it is likely that intraday credit markets will therefore develop: payments made early in the day may command a discount, while payments made late in the day may command a premium. A quantitative analysis of the relations between the size of payments-related overdrafts and liquidity in financial markets has proved elusive so far, but this is clearly an area of further research once data from the ongoing experiments become available.

Second, increasing the cost of daylight credit in central bank-based wholesale payment systems through collateralization or charges will create strong incentives to create private sub-netting systems as low cost alternatives to the real-time gross settlement systems with collateralized or interest-bearing overdrafts. Thus determined efforts to reduce daylight credit may only serve to shift such credit into private netting systems. While it is the prerogative of the central bank to regulate such private systems, such an approach would run the risk of distorting payments patterns. It may be preferable to manage the risk in an environment where it can be clearly observed.

Third, the ongoing and planned reforms will produce two different types of payment systems. The first is the proposed European real-time gross settlement system with collateralized interest free overdrafts supplied by

the central banks. The second is the U.S. real-time gross settlement system with uncollateralized overdraft that are subject to interest charges. The absence of a common architecture of wholesale payment systems for the major international currencies has raised the possibility that at planned levels of interest charges and at planned collateral requirements, the interest-free collateralized system could be more expensive for users than the system with uncollateralized overdraft and interest charges. In that case, it would be cheaper to execute and settle dollar-denominated wholesale payments. Thus, there would exist an incentive to redenominate financial transactions into U.S. dollars. In particular, a high degree of liquidity in U.S. money markets and the dollar foreign exchange markets makes it possible for money market transactions in less liquid currencies to be synthesized or replicated in the dollar markets. 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.

While the cost of reducing payments-related credit is its negative impact on market liquidity, the main benefit is that a financial disturbance, such as the failure of a major institution, would no longer threaten large parts of the financial system with payments gridlock. Hence central banks will no longer need to stand ready to rescue a large number of institutions perceived as too big to fail. Payment system reform thus holds out the prospect of strengthening the market mechanism in banking and finance, and of reducing the extent of the financial safety net.

Although the policy efforts in the payment system area have been ambitious and largely successful, a host of technical issues still remain to be addressed. The growth in international cross-border payments and securities transactions should be expected to continue and this development will create further challenges, such as issues relating to the linking of the major real-time gross settlement systems (as, for example, in Europe with TARGET) and linking RTGS systems with securities settlement systems to achieve delivery-versus-payments.

Furthermore, in a world with more and more domestic payment systems based on RTGS, banks will need to keep collateral balances at European-type systems. This will be highly inefficient for global institutions, as collateral balances could remain idle for most of the time. Hence arrangements for a global collateral pool may have to be explored. At the moment there are only a few commercial banks that are members of several domestic wholesale payment systems, but it is likely that growing globalization of securities markets will induce more banks to join several national payment system. These issues will require continued cooperative efforts among the major central banks in the coming years.

APPENDIX

Table A1. Main Large-Value Payment Systems in EU Countries 1/

Country	<u>Discrete-time settlement systems</u>		<u>Continuous-time settlement systems</u>	
	End-of-day	Multiple	Queuing	No Queuing
Belgium				
Clearing House of Belgium				
CEC	1974			
ELLIPS (planned)			P 1996	
Denmark				
DN System				1981
Greece				
Athens Clearing Office	1929			
Hermes (planned)			P 1996	
Ireland				
Daily Interbank Settlement	1980			
IRIS (planned)				P 1996
Luxembourg				
Clearing House	1925			
Netherlands				
8007 System	1982			
Central Bank System			> P 1996 <-	
Portugal				
Traditional Clearing SPGT		1995		
Spain				
STMD				
SLBE (planned)			P 1997	

Sources: Committee of EC Central Bank Governors, Payment Systems in EC Member States, Basle, 1992; Bank for International Settlements, Payment Systems in the Group of Ten Countries, Basle, 1993; Central Banks.

Note: P = Planned.

1/ Including countries not covered in Text Table 1.

APPENDIX

Table A2. Intraday Liquidity in RTGS Systems in Other EU Countries

Country	CB daylight overdrafts	Collateral requirement	Intraday use of reserves
Belgium			
ELLIPS (planned)	yes	full	n.a. <u>1/</u>
Denmark			
DN System	yes <u>2/</u>	no <u>3/</u>	n.a. <u>1/</u>
Greece			
Hermes (planned)	-	-	-
Ireland			
IRIS (planned)	yes	full <u>4/</u>	n.a. <u>5/</u>
Netherlands			
Central Bank System	yes	full	n.a. <u>1/</u>
Portugal			
SPGT (planned)	yes	full	full

Sources: Committee of EC Central Bank Governors, Minimum Common Features for Domestic Payment Systems, Basle, 1993; Bank for International Settlements, Payment Systems in the Group of Ten Countries, Basle, 1993; Central Banks.

Note: - = undecided

1/ Belgium, Denmark and the Netherlands have no (permanent) reserve requirement.

2/ Banks have access to daylight credit with Danmarks Nationalbank up to 100 percent of each bank's own funds.

3/ Danmarks Nationalbank is currently considering to introduce a collateral requirement for daylight overdrafts.

4/ In addition to the collateral requirement, the Central Bank of Ireland plans to charge (hourly) interest on (hourly) overdrafts and to pay interest, although at a lower rate, on surplus balances.

5/ Ireland has a low reserve requirement.

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