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Working Paper

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Working Paper, No. 370

Provided in Cooperation with:

Inter-American Development Bank (IDB), Washington, DC

Suggested Citation: Folkerts-Landau, David (1998) : Wholesale payments systems and financial discipline, efficiency, and liquidity, Working Paper, No. 370, Inter-American Development Bank, Office of the Chief Economist, Washington, DC

This Version is available at:

<https://hdl.handle.net/10419/87894>

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Wholesale Payments Systems and Financial Discipline, Efficiency, and Liquidity

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Washington, D.C., July 1997

Prepared for

Conference on
Building Modern and Effective Banking Systems in
Latin America and the Caribbean

Sponsored by
Inter-American Development Bank
Central Bank of Argentina

Buenos Aires
August, 7-8, 1997

¹Assistant Director, International Monetary Fund. Earlier versions of this paper have benefitted from comments received during seminars and discussions held at the following institutions: the Banca d'Italia, the Bank for International Settlements, the Bank of England, the Bundesbank, The Clearing House Interbank Payments Systems, the European Monetary Institute, the Federal Reserve Bank of New York, the Federal Reserve Board, and the Hong Kong Monetary Authority. The views expressed in this paper are those of the author and do not necessarily reflect the views of the International Monetary Fund.

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I. Introduction

The experience of a large number of countries since the mid-1970s has demonstrated the limited potential that an activist monetary and fiscal policy has in influencing real macroeconomic performance on a sustained basis. Instead, attention has again turned to questions regarding the contribution that market infrastructure can make to support and enhance economic performance. In light of the central role of the financial sector in pricing and allocating capital and risk, attention has focussed on questions relating to the architecture of this sector. Issues pertaining to the relation between the central bank, commercial banks, and the wholesale payments system; the financial supervisory and regulatory environment; the development of capital markets; pension reforms; and risk management have moved to the top of the reform agenda in many countries.

A key ingredient in achieving greater efficiency and better risk management in the financial system is a well-functioning wholesale payments system. Indeed, **payments systems are one of the most important features of a financial system that can contribute to a strengthening of market discipline in the banking system.** Here as elsewhere, the prospect of a bailout is inimical to market discipline: if banks expect that they will ultimately be indemnified for any losses resulting from bad debts, they have no incentive either to insist on periodic settlement in good funds or to monitor the creditworthiness of their counterparties. Arrears in payments will continue to mount, both within the banking system and elsewhere in the economy, and the size of the ultimate cost of the bailout will grow accordingly. If the creation of credit through the payments system is unchecked, it frustrates the system's purpose of facilitating the exchange of objects of value; it may instead become a mechanism through which transactors try to obtain a larger share of the eventual bailout. This outcome can be avoided by a discipline which requires that interbank settlement in good funds—central bank reserves—be made at sufficiently frequent intervals. Furthermore, 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, **the introduction of payments systems with strict settlement discipline will go a long way toward allowing the central banks to let 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 considers the lessons that are emerging from payments system reform currently underway in some of the major industrial countries.

II. Some Basic Operating Principles of Wholesale Payments Systems

The purpose of this section is to provide a broad outline of risk and risk-control features in wholesale payments 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.² These Lamfalussy standards first stress the legal basis of netting.³ 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 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.

²See the Committee on Interbank Netting Schemes of the Central Banks of the Group of Ten Countries (BIS, 1990).

³The 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.

In **real-time gross settlement or continuous settlement systems (RTGS)**, each interbank 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.

III. Current Initiatives in Reforming Payment Systems in Selected Industrial Countries

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 by forcing banks to internalize the cost of third party risk.**⁴

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

⁴See Passacantando (1991).

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.

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 to 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. 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.⁵

In the early 1980s, the increasing attention paid by the U.S. 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. Simultaneously, the risk of a systemic failure on CHIPS, the end-of-day net settlement system for Eurodollar and foreign exchange payments became evident. Recognizing these risks, the Federal Reserve implemented a twin-track risk reduction program—placing caps on the amount of uncollateralized overdrafts and pricing the overdrafts. 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

⁵See Committee of EC Central Bank Governors (1993).

cap of zero to those with a high level of overdrafts—2.25 times capital for overdrafts on any given day and 1.5 times capital for the average maximum overdraft during a two-week period.

To control risk on CHIPS, the New York Clearing House imposed a system of bilateral credit limits in 1984, net debit caps in 1986, and loss sharing 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.⁶ 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.

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. 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. 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.⁷ A minimum level of interbank credit is required for the smooth running of

⁶See Garber and Weisbrod (1992) and Schoenmaker (1995) for an extensive analysis of risk management in CHIPS.

⁷A 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
(continued...)

a 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, 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. The move toward RTGS was reinforced by the Ad Hoc Working Group on EC Payment Systems which established the principle that: "As soon as feasible, every member state should have a real-time gross settlement system into which as many large-value payments as possible should be channeled."

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 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.⁸ In contrast, although European central banks have repeatedly expressed their desire to implement

⁷(...continued)

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.

⁸See Horii and Summers (1994).

RTGS, commercial banks may still have a preference for net settlement, as netting reduces significantly the need for liquidity.⁹

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.¹⁰ 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.¹¹ 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.

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.¹² 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.¹³

⁹See Committee of EC Central Bank Governors (1992a), (1993) and EMI (1995).

¹⁰See Schoenmaker (1995).

¹¹See Schoenmaker (1995). It should be noted that potential further risk-reductions in RTGS systems via DVP-mechanisms are not included in this estimation.

¹²See Folkerts-Landau and Garber (1992).

¹³See Schoenmaker (1995).

IV. The International Dimension: 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. The two legs of foreign exchange transactions have to be settled in the national payment systems of the two respective currencies. 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. The surge in forex trading over the last decade is thus one of the major factors behind increasing payment volumes.

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.

The Noël Report explores different institutional approaches to reduce or eliminate Herstatt risk.¹⁴ 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

¹⁴See Committee on Payment and Settlement Systems of the Central Banks of the Group of Ten countries (1993a).

delays resulting from a liquidity shock in one system could, for example, cause settlement delays in other systems that are linked to it.¹⁵

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.¹⁶ This also generates substantial savings in settlement costs. However, the settlement of the net amounts is still subject to Herstatt risk. To comply with the Lamfalussy standards for multilateral netting schemes, participants are obliged to arrange firm financing for the largest net payment owed to the clearing house. This payment 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.¹⁷

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.

¹⁵For 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.

¹⁶See Glass (1994).

¹⁷See Duncan (1994) and Glass (1994).

V. Payments System 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. 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. 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 1 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.¹⁸

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.¹⁹ A general liquidity shortage in the money market during the day could cause settlement delays.

¹⁸The 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.

¹⁹For 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.

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.²⁰ 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.²¹

Sources of intraday liquidity

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. 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 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.²²

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

²⁰The 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.

²¹If 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.

²²This relationship will be positive, though non-linear. For example, it might follow the square-root relationship of a simple inventory model.

principally at the creditworthiness of the issuer.²³ 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.²⁴ The Bank of England will accept U.K. Treasury bills, eligible local authority bills and eligible bank bills as collateral.²⁵ 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.²⁶

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.²⁷ Moreover, securities eligible as collateral typically trade with a liquidity premium compared to ineligible securities with similar risk characteristics. If the range of securities is narrow compared to the amount of intraday liquidity needed, this liquidity premium can be substantial.

²³Other 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.

²⁴Eligible 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.

²⁵Eligible bank bills are commercial bills that are guaranteed, or accepted, by a U.K. bank.

²⁶See Bank of England (1994).

²⁷Both 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.

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.

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.²⁸ Swiss banks keep the level of reserves to a minimum by just meeting the low reserve requirement.²⁹ 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. 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.

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 £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.

²⁸Vital (1994).

²⁹The 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.

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. Assuming that the collateral constraint is binding, the total annualized cost of collateral holdings of £8.6 billion would then be £21.5 million.³⁰

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. 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.

³⁰The 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.

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.³¹ 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.³² 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. In Europe, bid-ask spreads on eligible securities will widen by less than spreads on ineligible securities.

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.**

³¹Japan, 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).

³²To 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 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.³³ 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.³⁴ Nevertheless, the overall risk to

³³See Garber and Weisbrod (1990).

³⁴Measures 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.

(continued...)

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 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.³⁵

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

³⁴(...continued)

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.

³⁵By 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.

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.³⁶

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 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

³⁶It 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.

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

Properly designed wholesale payments system can make a significant contribution to enhancing market discipline in the financial sector, reducing the risk of systemic disturbance, and permitting a less extensive safety net for financial institutions. A growing number of countries is currently reforming their wholesale, i.e. interbank, payments system to reap these benefits. 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 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 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.

Table 1. Intraday Liquidity in Selected RTGS Systems

| Country | CB Daylight Overdraft | Collateral Requirement | Intraday Use of Reserves |
|----------------|--------------------------|---------------------------|-----------------------------|
| France | Yes | Full | Full 1/ |
| Germany | Yes | Full | Full |
| Italy | Yes | Full | Full 2/ |
| Japan | No | ... | Full |
| Switzerland | No | ... | Full |
| United Kingdom | Yes | Full | Full 3/ |
| United States | Yes | No 4/ | Full |

1/ The amount of required reserves held by the French bank 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 allowed to use only a 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

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