Financial transactions generate a range of risks for counterparties that undertake them, their bankers and other intermediaries that process the transactions, and central banks through which final interbank settlement occurs. These risks are greatest in large-value interbank funds and securities transfer systems that support trading in financial markets. It is in these markets in particular that interrelationships between counterparties create the potential that disturbances in payment flows will have wider repercussions for the financial system and the economy as a whole.

This chapter describes and analyzes the risks borne by participants in payment systems. It outlines the basic steps and the types of risks that can arise in a financial transaction and shows how an intermediary providing payment services also takes on risks. It explains systemic risk, describes the risks that arise in netting arrangements, and deals with control of risk in net settlement and real-time gross settlement systems.

**Risks in Financial Transactions**

A transaction leading to a payment is typically a contract calling for an exchange between two parties. As illustrated in Chart 1, one leg of the exchange is the payment itself, while the other leg can be the delivery of a good or service. The delivery leg may also consist of a transfer of funds, for example, when the contract involves a foreign exchange transaction. Each exchange therefore involves risks both for the counterparties (X and Y in Chart 1) and for any intermediaries taking part in the payment.

The counterparties face two fundamental types of risk:

- Credit risk is the risk that participants in the transaction will not be paid for an outstanding claim. These participants include the counterparties themselves, the issuer of the settlement medium, and, if

---

any, intermediaries involved in the delivery of goods, services, etc. Credit risk typically arises when one of the participants becomes insolvent.

- Liquidity risk is the risk that the counterparty that owes funds will not be able to meet its payment obligation on time, thus adversely affecting the expected liquidity position of the recipient of funds at the time the funds are due.

The distinction between credit and liquidity risk is important. Credit risk entails the probability of a loss of principal and implies the possibility of associated liquidity risk. Liquidity risk principally entails a cashflow shortfall. The distinction may, however, not always be clear in practice. Indeed, liquidity shortfalls may be costly, forcing the party expecting a payment to engage in relatively expensive borrowing or unprofitable

**Chart 1. Structure of Exchanges**

![Chart 1. Structure of Exchanges](Image)
asset sales. If the liquidity shortfall is very serious, an induced default on other contracts, or even bankruptcy, may result. Cashflow shortfalls may thus be an important cause of credit risk. Whereas a liquidity shortfall in an exchange may arise because of a technical failure in the payment system, it can also stem from the credit loss associated with the unexpected bankruptcy of a counterparty.

Credit and liquidity risk can arise because of settlement lags, nonsynchronous settlement, or default by the issuer of the settlement medium. Moreover, a lag between the time a trade is agreed and settlement takes place creates the risk that the transaction may not take place at the time agreed owing to the failure of one of the parties to perform. For example, the transaction may be canceled or one of the two parties could default. One of the two parties would therefore suffer a loss if the terms at which it could replicate the transaction in the market moved against it in the intervening period, leading to an increase in the replacement cost of the transaction. In Chart 1, for example, suppose that counterparty Y sold a security to X and went bankrupt before the agreed settlement date, which is likely to be a number of days after the trade date. Counterparty X would then incur a loss if it had to purchase the security from another market participant at a higher price. In general, the longer the delay in settlement following the trade, the more likely it is that price changes may occur and thus the larger would be the potential replacement cost risk.

When the exchange of monetary value and the delivery of the good or service are not synchronous, the party performing its obligation first runs the risk that the counterparty may never perform its obligation. The nondefaulting party may receive only part or none of the value specified in the contract, thereby suffering a loss. This form of credit risk is known as principal risk. Again in Chart 1, suppose counterparty X purchased a security from Y and paid for it on the settlement date but before taking delivery. If Y were to default before delivering the security, X would lose the entire amount of its payment. Foreign exchange transactions in which the two payment legs are settled in different time zones are particularly vulnerable to this risk, commonly referred to as Herstatt risk. Herstatt risk is explored more fully in the appendix to this chapter.

Even if settlement is synchronous, the counterparty receiving payment would still be exposed to credit and liquidity risk if the issuer of the settlement medium is subject to default. As discussed in Chapter 2, although cash and central bank balances are free of this form of default risk, the liabilities of other payment intermediaries, such as commercial banks, typically are not.

It may be useful to illustrate these concepts with a simple example of a transaction involving cash. When an obligation is discharged using cash, for example, when a newspaper is purchased at a kiosk, settlement is immediate and simultaneous and occurs at the time of the transaction.
There is no settlement lag involved with respect to either the delivery of the newspaper or the payment. The exchange is fully synchronous. In more technical jargon, it can be said that the transaction is settled on a delivery-versus-payment (DVP) basis. Moreover, assuming there is confidence in the issuer of the bank notes (and the notes are not counterfeit), there is no default risk associated with the settlement medium. While cash payments may appear rudimentary, they actually combine essential features that are either absent or mimicked only with considerable difficulty in more sophisticated noncash payments, including interbank funds transfer systems.

**Risks Faced by Intermediaries**

The risks faced by payment intermediaries—commercial banks, other financial institutions, and the central bank—are analogous to those faced by the ultimate counterparties to the exchange. As shown in Chart 2, each intermediary is engaged in a type of exchange as a result of receiving funds on behalf of, and making funds available to, counterparties. As a result, intermediaries face liquidity risk whenever they do not receive funds on time but make funds available to the intended beneficiary in the transaction. Intermediaries face credit risks when the settlement of the transfer is not synchronous. This will occur if they make funds available to the next link in the payment chain (including the ultimate beneficiary) before receiving funds from the previous link (including the ultimate payor). Finally, intermediaries assume credit risk when accepting a risky settlement medium.

While time lags are a major source of payment system risk, other factors are also important. One is a payor’s ability to revoke payment or delivery orders before their execution or to make such orders conditional on a particular set of conditions. For example, a bank may credit a beneficiary’s account, and even allow the beneficiary to use the funds, on the condition that it receives the funds from the payor’s bank through an interbank funds transfer system. Similarly, participants in an interbank funds transfer system may retain the right to revoke individual transfers before a designated cut-off time. Or, the rules of a net settlement system may make all payment orders conditional on final settlement of participants’ multilateral net positions at the end of the day.

A final payment denotes a funds transfer that is irrevocable and unconditional, giving rise to the notion of finality. Only when a payment is final can an institution receiving the funds dispose of them knowing for certain that they are its to spend. If a payment is conditional, an intermediary that acts on incoming funds or that allows its customer to act on incoming funds before final settlement will be exposed to a credit risk. Pressures to
Chart 2. Risks in Intermediated Payments
(Credit transfer)

Credit (principal) risk

X vis-à-vis Y: transfer funds before receipt of item
Y vis-à-vis X: transfer item before receipt of funds
1 vis-à-vis X: transfer funds to 2 without availability of funds in X’s account
2 vis-à-vis 1: transfer funds to Y without availability of funds in 1’s account or before receipt of final funds from X on its central bank account
central bank vis-à-vis 1: transfer funds to 2 without availability of funds in 1’s account

Liquidity risk

1 vis-à-vis X: if X does not make funds available at time expected
2 vis-à-vis 1: if 1 does not make funds available at time expected
Y vis-à-vis 2: if 2 does not make funds available at time expected

treat conditional payments as final for purposes of access to funds can be great, especially in securities and foreign exchange markets where turnover is high.

Systemic Risk

The previous section outlined the credit and liquidity risks that intermediaries face if counterparties fail to meet their payment or delivery obligations in a transaction. Central banks are concerned not so much with the risks involved in individual transactions or single institutions, but rather with systemic risk. Systemic risk is the risk that credit or liquidity problems
incurred by one institution, or a small number of institutions, lead to similar difficulties for others.

The mechanism through which systemic risk manifests itself can be described as follows. One intermediary may be unable to settle, or face difficulty in settling, payments ordered by its customers. As soon as counterparties in financial markets sense the difficulties, they will move quickly to protect their own positions. Difficulties in determining the underlying creditworthiness of the troubled intermediary may induce its counterparties to withdraw funds held on deposit and to refuse to pay out funds on its behalf. To increase its liquidity, the intermediary suffering the problem may be forced to sell assets at unfavorable prices, thereby incurring losses that could lead to its insolvency.

Financial linkages between payment institutions can spread credit and liquidity problems widely, as participants in a particular market may, in turn, find themselves short of funds or face a decline in the value of their assets as a result of the actions taken by the troubled intermediary. Increased uncertainty about the size and distribution of exposures may lead banks to limit the credit they provide to their clients and to one another precisely when the need for liquidity rises. As a result, disturbances in the payment system may have profound ramifications across the economy.

Payment arrangements represent the connective tissue of all financial and real economic activity in a modern market economy. The ability to complete transactions, and confidence in counterparties to do likewise, underpins the smooth functioning of the payment system. Inevitably, therefore, the payment system is a key channel for the transmission of shocks across institutions and markets. It is primarily the real costs associated with a systemic payment system crisis that explain public concern for the safety and soundness of the financial system in general, and the payment system in particular.

From this perspective, large-value interbank funds transfer systems, such as those described in Chapter 6, deserve special attention, given that they lie at the heart of the payment process. A key question is how such systems would cope with the possibility that a participating bank may fail to provide funds at settlement. This settlement risk can imply a large liquidity shortfall for the other system participants and it may also involve credit risk. The specific nature of this settlement risk depends on whether the interbank transfer system settles on a deferred net basis or on a real-time gross basis.

**Risks in Net Settlement Systems**

In netting arrangements, payment orders are exchanged during a designated clearing period and settled at the end of that period. The values of
all incoming and outgoing funds transfers are offset for each participant during the clearing period. Netting can be bilateral, involving pairs of counterparties, or multilateral, involving three or more netting participants. In multilateral netting, settlement can be organized on a decentralized or centralized basis. When decentralized, an agent calculates net positions and each participant pays funds to (net debtors) or receives funds from (net creditors) a central settlement account maintained by a settlement agent. When centralized, a clearing organization becomes a central counterparty and assumes responsibility for paying net creditors, receiving its funds from net debtors. Chapters 3 and 4 explain that netting systems reduce banks' need for settlement balances and thereby add to the efficiency of the payment system. As a result of netting, however, risk pressures are concentrated at the end of the clearing period. The credit risk involved in these systems results primarily from the presence of a settlement lag, that is, the time between the beginning of the exchange of payment orders and their final settlement.

Chart 3 is an illustration of how credit risks arise in bilateral netting. Because there are only two banks involved in this example, a central clearing agent is not needed. The two banks in question rely on the settlement services of the central bank to achieve final settlement of their bilaterally netted payments. Between the time that bank Y credits enterprise B's account and the time at which final interbank settlement occurs across nostro accounts at the central bank, bank Y has an exposure to bank X. By making the payment to enterprise B, bank Y has, in essence, extended credit to bank X. This occurs because bank Y credits enterprise B's account and allows enterprise B to use the funds before it is actually paid by bank X. If bank X is the net debtor at the end of the clearing period, settlement of its netted obligations will take place at the end of the period through a funds transfer from its nostro account at the central bank to the nostro account of bank Y.

In an interbank netting system with end-of-day final settlement, intraday credit is tacitly extended by a receiving bank that accepts and acts on a payment order knowing that it will not receive final funds until the end of the clearing period. Participants in bilateral netting can assess their counterparty credit risk directly. Multilateral netting involves three or more parties and leads to a mutualization of credit and liquidity risk, calling for more sophisticated risk management techniques. The mutualized obligations and claims are satisfied and made, respectively, through a clearing arrangement. It is through this clearing arrangement that risk controls must be implemented. If the payment order is in favor of the receiving bank’s customer and the receiving bank is confident that the sending bank will ultimately settle for the transfer(s), it may make funds available to its customer(s) before settlement. Indeed, the rules of some netting arrangements explicitly require that banks receiving payment
In the example, enterprise A instructs its bank, bank X, to pay enterprise B, which has an account at Bank Y. Bank X sends a message directly to bank Y, and bank Y credits enterprise B with funds that cannot be revoked. Enterprise B is free to withdraw the funds immediately (and is likely to do so, especially if it is trading in securities or foreign exchange markets). At the end of the clearing period, bank X and bank Y confirm their net settlement balances. Bank X can settle its net obligations by ordering a funds transfer from its nostro account at the central bank to the nostro account of bank Y.

orders credit their customers’ accounts immediately. The receiving bank is then exposed to credit risk, because the customer may withdraw funds or retransfer them and, if settlement does not occur, the receiving bank will not have received payment from the sending bank.

The timely settlement of the underlying gross transactions that are included in a multilateral net settlement system depends on the ability of each participant in a net debit position to meet its obligation arising from the netting. The critical question is, what happens if a bank fails to meet its net debit obligation at the end of the day? There are two broad possibilities. First, if the central bank underwrites the settlement, it would make good on the obligation of the bank failing to settle. In agreeing to guarantee the settlement of a participant in a netting system, and thus averting an immediate liquidity crisis for other participants, the central bank may require other banks participating in the system to share in the
loss after the fact. Irrespective of how losses are subsequently borne, each
day's settlement will take place and any potential crisis would be short
circuited.

Second, the bank participants in the netting arrangement may them­
selves deal with any crisis caused by the failure of one of the members of
the system to settle. In this case, the central bank does not stand ready to
absorb losses and guarantee settlement. Rather, the banks participating in
the multilateral netting system will rely on the contingency arrangements
they have agreed upon to deal with a settlement failure. The design of a
multilateral netting system, particularly arrangements in place to deal with
a failure to settle by one or more participants, will determine how safe the
system is.

One method for dealing with settlement failures is to unwind the settle­
ment. This means that some or all of the underlying payments involving a
participant that is unable to meet its settlement obligation are deleted
from the netting, and the settlement positions of the remaining participa­
tants are recalculated. Such a procedure has the effect of reallocating
liquidity pressures and potential losses from the failed bank to the remain­
ing participants in the system. An unwind is generally considered to be an
unsatisfactory method of dealing with the failure of a participant to settle
its obligations, because participants that had been net creditors of the
failed institution will be adversely affected when expected funds are not
forthcoming. Unwinds are generally tolerated only for small-value net
settlement arrangements where concerns about systemic risk are minimal.

An example of the repercussions of an unwind in a multilateral net
settlement system is shown in Table 1. This example is based on the
multilateral netting example shown in Table 1 of Chapter 3. In that exam­
ple, the net claims (+) and obligations (−) of the participants were
A(−130), B(+100), C(+30), D(0). Here, Table 1 shows the effects on the
multilateral net positions of the other participants if bank A cannot settle
its original net debit position of 130 and the settlement is unwound, that
is, all transactions to and from bank A are eliminated from the settlement,
resulting in a new set of net claims or obligations for the remaining banks.
In the example, bank B's net credit position is reduced from 100 to 80 and
bank C's position changes from a net credit of 30 to a net debit of −10.
Bank D's position, which was originally zero, also turns into a net debit of
−70. Thus, both banks C and D suddenly and unexpectedly find them­
selves with net debit obligations to fulfill. They will need to raise funds to
meet their newly calculated obligations before settlement can occur. A
bank unexpectedly facing a need for liquidity may have to compete for
funds with others also suddenly having to raise liquidity. If either bank C
or D were unable to fund the new net debit position following the un­
wind, then its transactions would, in turn, have to be deleted, possibly
causing knock-on effects for other institutions. In this way, unwinds can
Table 1. Deletion of Bank A’s Transactions from Multilateral Net Settlement System

<table>
<thead>
<tr>
<th>Bank sending payment</th>
<th>Bank receiving payment</th>
<th>Sum of obligations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>A</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>B</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>C</td>
<td>—</td>
<td>50</td>
</tr>
<tr>
<td>D</td>
<td>—</td>
<td>30</td>
</tr>
<tr>
<td>Sum of claims</td>
<td>—</td>
<td>80</td>
</tr>
</tbody>
</table>

II. Recalculated Net Claim (+) or Obligation (-) of Each Bank with Clearinghouse

<table>
<thead>
<tr>
<th>Bank</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Net net</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>—</td>
<td>80</td>
<td>-10</td>
<td>-70</td>
<td>0</td>
</tr>
</tbody>
</table>


cause considerable disruption to the underlying flow of payments through the economy.

Simulation exercises have been conducted using actual transaction flows for multilateral net settlement systems to assess the likely extent of knock-on effects from undertaking an unwind following the failure of a single participant. Simulations performed using 1983 data for CHIPS, for example, suggested that the failure of a large netting participant to settle could result in close to half of all other participants in turn being unable to settle. The results also indicated that the institutions affected by a failure to settle varied substantially depending on the particular day’s data used for the simulation and that, because of the knock-on effects, banks not involved in transactions with the institution failing to settle could be adversely affected.

Results such as those described above underscore that unwinds can be a significant source of systemic risk. Because of systemic risk, both participants in net settlement systems and central banks have been working to develop arrangements that ensure that settlement can take place in the event of difficulties faced by participants in the arrangements. By putting...

---

into place methods to guarantee settlement, the possibility of needing to resort to an unwind is reduced. The following section discusses some of the steps that have been taken to reduce the possibility of a settlement default and to limit the disruption if one should occur.

**Controlling Risk in Net Settlement Systems**

Disturbances in the settlement process can directly affect central banks as the ultimate providers of interbank settlement services, as lenders of last resort to the banking system, and in their conduct of monetary policy. Reflecting these concerns in 1990, the central banks of the Group of Ten countries established a set of minimum standards applicable to the design and operation of cross-border and multicurrency netting schemes, especially those handling large-value funds transfers. These standards apply equally to domestic interbank net settlement systems. The Lamfalussy standards (named after the chairman of the committee that developed them) are designed to control risk in netting schemes; they are set out in Table 2. It has become accepted that all large-value funds transfer systems should be moving to meet them. Accordingly, this section uses the Lamfalussv standards as a framework for analyzing the issues that need to be addressed if risk is to be controlled in deferred net settlement systems.

Any netting scheme needs to have a well-founded legal basis. When a netting scheme is legally binding, banks can be assured that their obligations are limited to the net amounts arising from the netting. Without a sound legal basis, a liquidator may be able to engage in “cherry-picking,” insisting on the performance of obligations that favor the failed institution and defaulting on those that would disadvantage it. The result could leave counterparties faced with paying away gross obligations to the failed institution and not being paid in return. There are a number of legal forms of netting schemes in use. One is netting by novation, under which each new transaction becomes part of a single contract capturing the running balances due to or from each party.

Institutions that participate in deferred net settlement systems should have a clear understanding of the financial risks to which they are exposed. In particular, they should understand that their liquidity obligations are concentrated at the end of the clearing cycle. Acting on this understanding, they should make adequate provisions to meet the highest possible obligation arising from their own trading and any contingent obligations they would be required to assume if another institution participating in the scheme was to fail.

The third, and potentially most complex, requirement is that netting schemes should have clearly defined procedures for limiting and managing credit and liquidity risks. An important means to limit risks is to restrict
Table 2. Minimum Standards for Design and Operation of Cross-Border and Multicurrency Netting and Settlement Schemes

I. Netting schemes should have a well-founded legal basis in all relevant jurisdictions.

II. Netting scheme participants should have a clear understanding of the impact of the particular scheme on each of the financial risks affected by the netting process.

III. Multilateral netting systems should have clearly defined procedures for the management of credit risks and liquidity risks that specify the respective responsibilities of the netting provider and the participants. These procedures should also ensure that all parties have both the incentives and the capabilities to manage and contain each of the risks they bear and that limits are placed on the maximum level of credit exposure that can be produced by each participant.

IV. Multilateral netting systems should, at a minimum, be capable of ensuring the timely completion of daily settlements in the event of an inability to settle by the participant with the largest single net debit position.

V. Multilateral netting systems should have objective and publicly disclosed criteria for admission, which permit fair and open access.

VI. All netting schemes should ensure the operational reliability of technical systems and the availability of backup facilities capable of completing daily processing requirements.


...
occur. The fourth Lamfalussy standard requires that systems should be capable of ensuring the timely completion of daily settlement. It is not sufficient to limit the size of the liquidity shortfall; participants must be able to meet it so that settlement can proceed and the dangers of an unwind can be avoided. There will be no time for negotiating lines of credit or other sources of liquidity, or a loss-sharing agreement, once a crisis arises. Loss-sharing rules allocate losses on the basis of a preagreed formula, usually based on the amount of bilateral credit each "surviving bank" has granted to the defaulting bank.

Liquidity problems can still arise if contributions to the loss-sharing are made only after a crisis has arisen. This, of course, would be a very difficult time to raise liquidity and settlement could not occur if some banks were unable to meet their obligations under the loss-sharing rules. To avoid this problem, it is prudent to require that the participants in multilateral netting systems set aside and commit collateral as a condition of participation. If a participant in the settlement arrangement fails to meet its obligation, enough of the collateral lodged by the failed and all the surviving banks would be liquidated to pay the obligations of the failed bank. Although the surviving members would have to replenish the collateral, the immediate crisis would be forestalled. Chapter 6 describes how limits have been set and settlement underpinned by the establishment of a collateral pool for CHIPS.

The fifth standard emphasizes membership criteria. One way of reducing settlement risk in multilateral netting systems is through appropriate membership criteria. In particular, institutions that are financially strong are less likely to fail than are weaker institutions. Membership criteria will be more important for participation in large-value deferred net settlement systems than for real-time gross settlement systems (see below).

Finally, the Lamfalussy standards emphasize operational reliability. Since a technical failure involving computer systems can cause severe disruptions to liquidity flows, it is common that members be required to meet high operational standards, including having back-up systems that allow members to recover quickly from computer failures (see Chapter 12).

The Lamfalussy report emphasizes that any large-value netting scheme should be closely supervised by the appropriate central bank. This reflects central banks' broader objective of limiting systemic risks in payment systems and financial markets. In undertaking such supervision, however, central banks must be careful that their efforts to limit systemic risk do not actually encourage undesirable risk-taking by banks. In particular, banks will be less likely to control the riskiness of their behavior if they perceive that the central bank is willing to absorb risks. In other words, as the perceived likelihood of central bank support grows, market participants may engage in increasingly risky activities. This problem is known as moral hazard.
Multilateral net settlement systems may be particularly susceptible to moral hazard. The number of banks participating in such systems and the major disruption that an unwind of funds transfers could cause create pressure on the central bank to act to avert settlement failures. As a result, privately owned and operated multilateral net settlement systems may be designed without sufficient regard to the need for built-in mechanisms and incentives to control risks.

Two important points should be made about the translation of the Lamfalussy standards into operational and legal underpinnings, credit controls, and related banking practices. The Group of Ten central banks deliberately set out the standards in general terms, recognizing that designers of systems in particular countries would face and need to deal with a variety of legal requirements, financial structures, and long-established banking conventions. Close consultation will be needed between central and commercial banks to ensure that risk controls are optimal, meaning, in part, that they are not too costly. An appropriate degree of risk control is most likely to be achieved when it is realized from the start that efforts to contain risks in interbank settlement systems will benefit the entire financial system and the individual system participants.

The committee also emphasized that these standards should be seen as minimum standards and that practices should continue to be strengthened over time. Along these lines, a number of countries have decided that their existing deferred net settlement systems cannot be upgraded to a satisfactory level to serve as the mechanism for their time-critical large-value payments. They have instead turned to real-time gross settlement systems.

**Controlling Risk in Real-Time Gross Settlement Systems**

This section describes the type of settlement risk that can arise in the operation of a real-time gross settlement system and the means by which it can be controlled. The analysis and descriptions provided in Chapter 6 for specific types of real-time gross settlement systems are generalized here.

Real-time gross settlement systems may or may not provide intraday credit to facilitate the timely settlement of payments. When credit is not provided, as in the Swiss Interbank Clearing System (SIC), banks have to give a great deal of attention to managing their liquidity and payment flows if they are to make customer payments as requested. In well-developed banking systems with liquid money markets, banks can borrow from one another to replenish their accounts at the central bank. Such borrowing and lending typically takes place on an overnight basis. It is also possible, in theory, for banks to borrow and lend on an intraday basis, that is, for periods of up to a few hours. The need for an intraday
market depends on the alternative intraday funding facilities, such as a repo facility, that may be provided by the central bank. Intraday funds markets are not yet well developed, even in major financial centers.3

Managing liquidity through the interbank markets can be difficult when payment flows are volatile and unpredictable. From time to time, banks may find that they need to hold back outgoing payments while they await incoming payments to replenish the balances in their accounts at the central bank. The resulting queuing of payments can be disruptive to both the originators and the receivers of payments who may be counting on immediate, or at least very timely, settlement. Moreover, depending on the circumstances, and especially during periods of financial stress, the inability of a bank to make real-time payments without undue delay could raise doubts in the rest of the market about its liquidity.

To alleviate these potential pressures arising from a strict “no-overdrafts rule,” some central banks operating gross settlement systems provide limited overdraft facilities to banks. Intraday overdraft facilities typically take the form of automatic advances when payments are made but funds are not on deposit. To protect itself from credit risk, the central bank may require that intraday borrowing be secured and limits may be placed on the maximum amount that can be borrowed. If it allows a bank to overdraw without collateral during the day, the central bank assumes credit risk.

Reliance on a real-time gross settlement system does not mean that systemic risk is absent in a financial system. Rather, a bank’s obligations can accumulate during the day if it does not have the funds or credit capacity to make its payments. If this results in the delay of a large number and value of transfers, the initial impact could be similar to that resulting from a settlement failure. The main difference is that in deferred net settlement systems, counterparties may assume during the clearing period that payment orders will be settled and can be redeployed in the interim. Unless the netting system fully meets the Lamfalussy standards, settlement may not be assured. In a real-time gross settlement system, participants are under no such impression, since they cannot respend payments that have not been received. Nevertheless, the failure of a large bank to make its payments could have knock-on effects on others, including both other banks and their customers, possibly leading to payments gridlock with potential systemic consequences.

Conclusions

Financial institutions exchanging payment instructions face two key risks in the clearing and settlement process. Credit risk arises if one of the parties

3The funding alternatives described here are explained in more detail in Chapter 4, particularly in relation to a particular country’s monetary regulations and procedures.
cannot meet its obligations; liquidity risk results from an unexpected de­
lay in a party meeting its payment obligations. Both risks are particularly
important in large-value funds transfer systems, which form the core of
the payment system, because a significant liquidity shortfall may be
quickly transmitted from one financial institution to another, a condition
known as systemic risk. Systemic risk is of particular concern in large-
value transfer systems that provide funds transfer facilities to the financial
markets. In this environment, funds may be retransferred many times
during a trading day, with parties assuming that each transfer is final. This
assumption may not hold for a deferred net settlement system. If a partici­
pant in such a system is unable to settle and transactions have to be
unwound, the knock-on effects to other participants, even those that have
not traded with the failed participant, can be substantial.

For these reasons, central banks have taken a keen interest in improve­
ments in the robustness of deferred net settlement systems and their ability
to withstand shocks. In particular, they have sought to ensure that such
systems can settle in a timely fashion, even if a member with a large net
debit is unable to meet its obligation. The six so-called Lamfalussy stan­
dards are now widely accepted as the minimum standards that need to be
met if risk is to be controlled in large-value deferred net settlement systems.

A number of countries that do not already have them are installing real­
time gross settlement systems for large-value payments. Although finan­
cial risks are not eliminated in such systems, they are significantly
changed and can be reduced compared with net settlement alternatives.
In particular, the scope for the large-value payment network to transmit
shocks throughout the financial system, so-called systemic risk, is mark­
edly reduced.

**APPENDIX**

**Risks in the Settlement of Foreign Exchange Transactions**

The major risk in the settlement of foreign exchange transactions arises
because each of the two legs of the transaction is settled across domestic
large-value payment systems in different countries, often in different time
zones. Whenever the two counterparties do not receive final funds de­
nominated in each of the currencies at the same time, they expose them­
selves to both credit and liquidity risk. These risks can have serious sys­
temic implications because foreign exchange transactions account for a
large share of the value of payments in the major financial centers and
because most of them are entered into by banks.
Foreign exchange settlement risk arises mainly because of differences in time zones and opening hours of interbank funds transfer systems across countries. There is currently no overlap at all in the operating hours of the funds transfer systems of the countries of the three most actively traded currencies—the U.S. dollar, the Japanese yen, and the deutsche mark. As settlement in each currency typically takes place in the country of issue, the counterparties to a transaction are thereby exposed to liquidity or credit risks.

Since most spot foreign exchange transactions settle two business days after the trade date, counterparties to trades run the risk that their counterparts will not be able to honor their commitments at the designated settlement time. Counterparties therefore are exposed to replacement cost risk, which, in foreign exchange transactions, can be considerable given the potential volatility of exchange rates.

More important, the party paying final funds first on the settlement date is exposed to principal risk, because it pays before the counterparty completes the other leg of the transaction. Should the counterparty default and fail to pay the second leg, the bank that paid away the first leg of the transaction may not be able to recover its funds. The time lag can be particularly long in a yen/dollar transaction. Assuming that the counterparties obtain final funds only at the end of the opening hours of the interbank systems handling yen and U.S. dollars (typically FEYSS and CHIPS), the party paying out yen pays out the funds over 15 hours before receiving dollars. In a deutsche mark/U.S. dollar exchange, the time lag is still about 10 hours.

The risks raised by the asynchronous settlement of foreign exchange transactions were highlighted in July 1974, when Bankhaus Herstatt, a relatively small German bank very active in foreign exchange dealings, was ordered into liquidation by the German banking supervisory authorities, thereby suspending all payments. The suspension and related announcement took place after the closing of the interbank funds transfer system in Germany so that all of Herstatt's deutsche mark payments and receipts were made, but before its U.S. dollar obligations were to be settled on CHIPS. As a result of its failure, Herstatt did not complete payments to its counterparties in U.S. dollars and a number of them faced losses as a result of the asynchronous settlement of funds.

Although average exposures in 1974 were much smaller than at present, the Herstatt episode caused great disruption to the interbank clearing system in the United States and in particular to CHIPS. The disruption was related, in part, to declining confidence that spread to counterparties generally. Creditors did, in the end, receive partial compensation for the losses suffered, but the episode illustrated how uncertainty regarding the size, distribution, and resolution of exposures might lead to a broader financial crisis.