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Payment Systems

David Sheppard

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no.8

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Foreword

This series of *Handbooks in Central Banking* has grown out of the activities of the Bank of England's Centre for Central Banking Studies in arranging and delivering training courses, seminars, workshops and technical assistance for central banks and central bankers of countries across the globe.

Drawing upon that experience, the *Handbooks* are therefore targeted primarily at central bankers, or people in related agencies or ministries. The aim is to present particular topics which concern them in a concise, balanced and accessible manner, and in a practical context. This should, we hope, enable someone taking up new responsibilities within a central bank, whether at senior or junior level, and whether transferring from other duties within the bank or arriving fresh from outside, quickly to assimilate the key aspects of a subject, although the depth of treatment may vary from one *Handbook* to another. While acknowledging that a sound analytical framework must be the basis for any thorough discussion of central banking policies or operations, we have generally tried to avoid too theoretical an approach. Moreover, the *Handbooks* are not intended as a channel for new research.

We have aimed to make each *Handbook* reasonably self-contained, but recommendations for further reading may be included, for the benefit of those with a particular specialist interest. The views expressed in the *Handbooks* are those of the authors and not necessarily those of the Bank of England.

We hope that our central banking colleagues around the world will find these *Handbooks* useful. If others with an interest in central banking enjoy them too, we shall be doubly pleased.

Needless to say, we would welcome any comments on this *Handbook* or on the series more generally.

Lionel Price
Director of Central Banking Studies

Tony Latter
Director for Technical Assistance and Series Editor

ABSTRACT

Payment systems come in many forms, but their purpose is always the same - namely, to enable people to transfer funds from an account at one bank to an account at another bank. The alternative for the payer and the payee would be to settle their transaction either using cash or by barter. Banks themselves also use payment systems to transfer funds as a result of their own transactions (as distinct from their customers').

Whatever its particular form, a payment system can be seen as comprising three main elements or processes:

(i) A means of *authorising and initiating the payment* ie the means by which the payer gives authority to his bank for funds to be transferred.

(ii) A means of *transmitting and exchanging the payment instruction* between the banks involved - usually referred to as clearing.

(iii) A means of *settlement between the banks involved* - ie the payer's bank has to compensate the payee's bank, either bilaterally or through accounts that the banks hold at a third-party settlement agent, usually (but not always) the central bank.

This *Handbook* considers these processes in more detail, and in particular the risks and policy issues that they present. A recurring theme is that, while there are a number of common risks and problems to be addressed, there is no single ideal way of addressing them. Solutions adopted in one country may not necessarily be appropriate in another. Another important message is that, in developing a new payment system or modifying an existing one, the emphasis must be on agreement and co-operation - both between central bank and commercial banks as the operators of the system, and between the system operators and its customers.

PAYMENT SYSTEMS

1 Role of the central bank in payment systems

Why payment systems matter

For many years, the operation of payment systems was generally not considered to be a subject for active central bank interest or concern: they were seen essentially as a mechanical, 'behind-the-scenes' activity which raised no real questions of policy. That attitude has now changed. In the main developed market economies, the last 15 years or so have seen:

(a) A massive increase in the turnover of the payment systems, both in terms of the numbers of transfers made, and more importantly in terms of the value of those transfers. This has reflected in particular the rapid growth in financial market activity around the world and the payments which such activity generates.

(b) Major technological advances, as a result of which funds can be moved much faster through the payment systems.

Table 1 illustrates the magnitude of payment system flows in the G10 economies. Thus, looking at the UK data, annual payment system turnover is 42 times greater than annual GDP; in other words it takes roughly six working days for the UK payment systems to process a value equal to the country's annual GDP. The figures are even more impressive for some other countries - Switzerland, Japan and the USA.

So, there is now a widespread understanding and appreciation of the pivotal role that payment systems play in any market economy:

- as a vital element in the financial infrastructure of the economy;
- as a necessary channel for effective economic management, particularly through monetary policy;
- as a means of promoting economic efficiency.

Table 1: PAYMENT FLOWS AND GDP IN G10 COUNTRIES
(1994 data)

	Annual turnover in payment systems ($000 billion)	Ratio of payment system turnover to GDP	ie. Number of days to turn over annual GDP
BELGIUM	10.9	47.5	5¼
CANADA	11.6	20.7	12
FRANCE	58.3	43.9	5½
GERMANY	129.1	63.0	4
ITALY	20.4	29.9	12½
JAPAN	463.4	100.9	2½
NETHERLANDS	12.4	37.5	6¾
SWEDEN	6.4	32.6	7¾
SWITZERLAND	24.5	93.9	2¾
UK	42.9	41.9	6
US	506.5	73.7	3¼

Each of these roles will now be briefly examined.

Payment systems and financial stability

Given the pivotal position of payment systems, it is not difficult to see how a disruption in their operation could have a serious impact on the financial markets which they serve. For example, as a result of a major payment system failure, payment obligations generated in a particular market might not be met on time; as a result, confidence not only in the financial standing of particular traders in that market but also in the liquidity and stability of the market as a whole could be undermined.

Conversely, it is possible for an adverse development in a financial market or institution to have a disruptive impact on the operation of the payment system. Thus, if a financial problem arises that directly affects one or more of the banks operating in the payment system, then the other member banks in the system may fear subsequent difficulties in the interbank settlement and so delay sending transfer instructions to the affected banks. If the problem is sufficiently widespread or the affected

bank is sufficiently important within the payment system, then 'gridlock' may ultimately result, with payments blocked throughout the system.

There is, therefore, a two-way interaction between stability in financial and banking markets and stability within the payment system. Bank and financial market supervisors need to communicate closely with the payment system overseers so as to ensure that, as far as possible, problems of the sort described can be anticipated and resolved at an early stage.

Payment systems and monetary policy implementation

The large-value payment system of a developed market economy has a major role to play in the successful implementation of the key responsibility of every central bank - namely achieving and maintaining monetary stability.

In a modern market economy, the main instrument of monetary policy is the short-term interest rate - the rate of interest at which the commercial banks can borrow from and lend to each other in the money markets. Central banks control this interest rate through their ability - as the ultimate provider of liquidity to the banking system - to influence the balance between the supply of and demand for funds in the money markets. In some countries, changes in the level of mandatory reserves that the commercial banks hold with the central bank are used to influence the supply/demand balance and hence generate the required movement in short-term interest rates, and thence in the whole spectrum of interest rates in the economy. In other countries, as for example in the UK, the central bank's open market operations are designed to ensure that each day the money market as a whole faces a potential shortage, which the central bank then relieves at the interest rate it wishes to see established or maintained in the market.

Both methods represent a market-orientated approach to monetary policy implementation, and as such require that:

- the interbank money markets are actively used by borrowers and lenders (ie are liquid) and are thus a reliable indicator of monetary conditions in the economy as a whole;

- the central bank can reliably forecast the major daily influences on money-market liquidity - particular the main flows of money between the government and private sectors (for example, tax receipts on the one hand, government expenditures on the other).

A reliable large-value payment system with same-day settlement is very much a requirement for meeting both of these conditions.

Payment systems and economic efficiency

If a payment system is inefficient and unreliable, it may take weeks rather than days for a payment instruction to move from the payer's bank to the payee's bank and for the final recipient's account to be credited. In addition, the timing of this process may be uncertain: it could take just a few days on one occasion, but two weeks on another. Such inefficiencies in the payment system are not just an inconvenience to the users, but can have an adverse impact on how the economy works. If money is "tied-up" in the payment system, then it is not available for other, productive, purposes. Similarly, if economic agents cannot accurately predict the arrival of funds, then it is more difficult for them to plan their expenditures in an efficient and cost-effective manner.

The extent and nature of a central bank's involvement in payment systems

The operation of payment systems is thus closely related to the two key central banking objectives of monetary stability and financial stability, and will have a bearing on the wider objective of economic welfare. So, what role should the central bank have in relation to a country's payment systems, so as to ensure that they develop in such a way as to further these objectives? In answering this question, one can first of all

consider the various possible roles for a central bank in the operation of the payment systems. These can be classified in terms of four separate functions:

(i) as a *user of payment systems*. A central bank has its own transactions to carry out, requiring the movement of funds. Most obviously these include settling official open market operations through the payment system, so as to implement monetary policy; settling payments for official transactions in government securities (including new issues and redemptions), either short-term in the money markets or longer-term in the government bond markets; and settling the domestic currency leg of official foreign exchange transactions. And, like any other enterprise, the central bank will also have bills, salaries, pensions, etc to pay, all requiring the use of a payment system.

(ii) as a *member of payment systems*. As a member, the central bank can make and receive payments on behalf of its own customers, for example government departments and other central banks.

(iii) as a *provider of payment services*. These services can include the provision of settlement account facilities to the commercial banks operating in the payment systems; and providing - either on its own or jointly with commercial banks or other commercial entities - the system hardware, software, operating procedures, or the communications network for the payment systems.

(iv) as '*guardian of the public interest'*. This role is much broader and may involve any of the following: acting as payment system regulator; acting as supervisor of system members (banking supervisor); providing administration and planning for the payment systems; arbitrating in the event of complaints and handling compensation procedures. The central bank may also be involved in wider issues such as promoting competitiveness, or encouraging the development and adoption of technical standards.

A fifth function for the central bank which should, if at all possible, be avoided is that of guarantor of the daily settlement - effectively using

public funds to underwrite the commercial banks' obligations arising from their payment system activity. This subject will be examined in greater detail later.

A survey of the major developed market economies reveals great variations in the extent of central bank involvement in payment systems. These variations to a large extent reflect the different economic, social, legal and political backgrounds of the countries concerned. Thus, some central banks are very closely involved in the provision and running of payment systems (for example, France, Germany, Italy, Spain); some have wide regulatory powers, which may be related to specific statutory responsibilities (Germany, Italy, Sweden); and some are actively involved in the business of making payments for customers. In the United Kingdom, however, the central bank is not particularly active in any of these respects. Instead emphasis is placed on the commercial provision of payment services, with the legal framework based very much upon the law of contract, while the Bank of England concerns itself with the overall soundness of the systems .

Whilst there are different approaches to central bank involvement in payment systems, the ultimate aims will be the same - namely to ensure the continuing availability of systems which as far as possible meet all users' needs, and which operate at minimum risk and at reasonable cost.

2 Initiating a payment - the choice of payment instrument

Identifying payment needs

The initiation of a payment is the first, and in many ways the most visible, step in the whole process of transferring funds between the bank accounts of different customers. The selection of payment instrument for a particular transaction will depend on the answers to a range of questions:

- what is the cost to the customer of using particular instruments?
- is the transaction ‘face to face’ (eg in a shop) or a ‘remote’ transaction?
- is it a regular (monthly, quarterly) transaction or a ‘one-off’ transaction?
- is it urgent (eg requiring same-day availability of funds to the receiver) or non-urgent?
- is it a high-value or low-value payment?
- is it a local or long-distance payment?
- is it domestic or cross-border?

The range of payment instruments available in any particular country will necessarily reflect that country’s historical and social background. However, it is important that the choice should also as far as possible be a reflection of that country’s developing non-cash payment requirements.

Three main characteristics of payment instruments

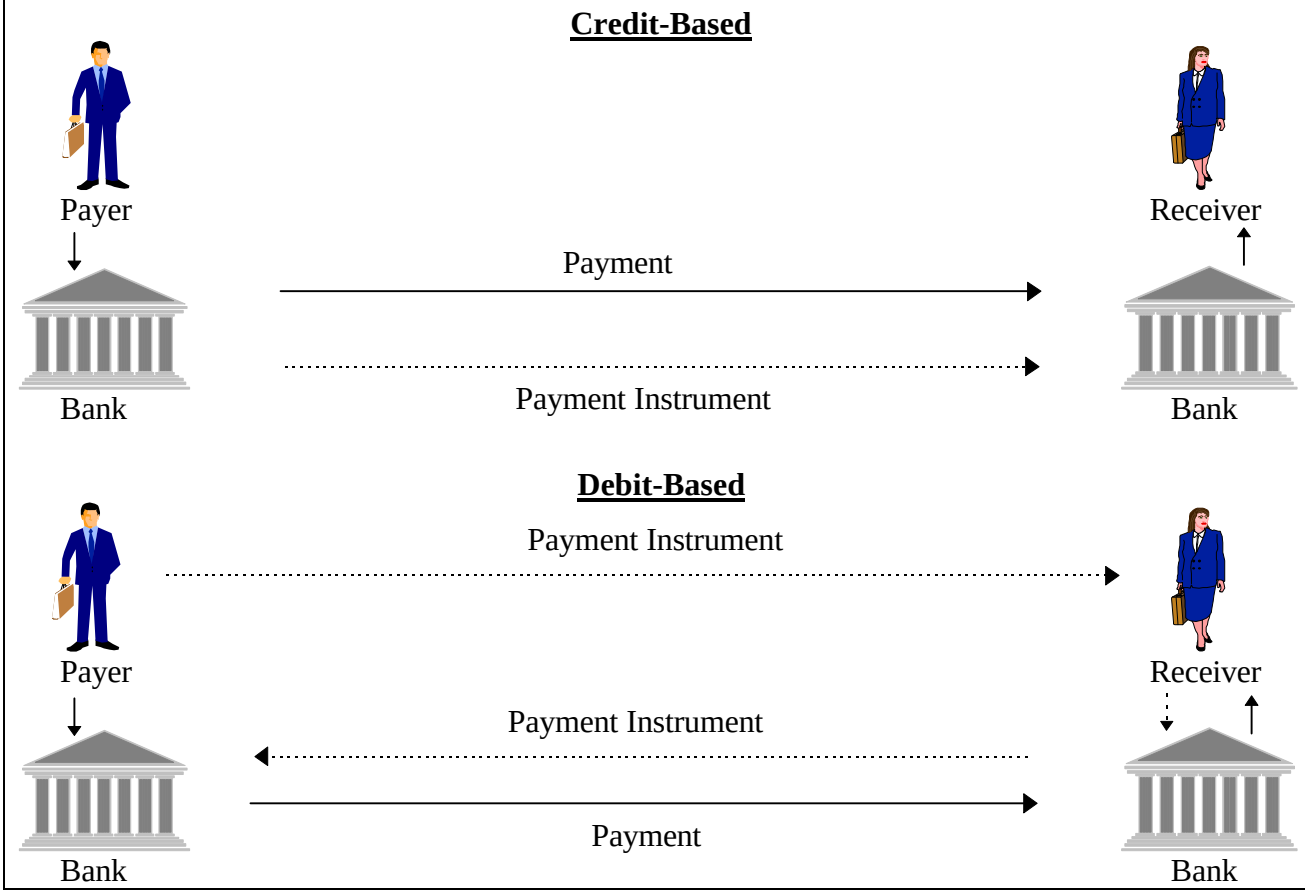
(a) *physical form*

This is the most obvious categorisation of payment instruments. Traditionally, the physical form of a payment instruction has been paper: cheques or payment orders, for example. Today, it is increasingly likely to be a payment card of some sort; or the sender may arrange (in person, or by telephone, fax or telex) with his bank for an electronic instruction to be sent.

(b) *security features*

Closely related to the physical form of the payment instruction are the security features that it incorporates - the means of checking that the instruction is genuine, and has not been fraudulently produced. Traditionally, this was by means of a person’s signature. Today it may more often be by means of a personal identification number (PIN) entered by the sender, or in the case of direct electronic instructions, by the use of a password.

Diagram 1: CREDIT-BASED VERSUS DEBIT-BASED PAYMENT INSTRUMENTS



(c) *credit-based versus debit-based transfers*

This is perhaps a less immediately obvious distinction, but nonetheless an extremely important one. When a credit-based instrument is used (for example, a payment order), the sender gives the instruction directly to his own bank for onward transmission to the receiver's bank. When a debit-based instrument is used (such as a cheque), the sender first of all gives the instruction to the receiver himself, and the receiver then passes the instruction to his bank, which will in turn pass it to the sender's bank. So, as can be seen from Diagram 1, for a credit-based transfer, instruction and funds move in the same direction, whereas for a debit-based transfer they move in opposite directions.

The choice between credit-based and debit-based instruments will be considered in the course of the following section, which looks in a little more detail at some of the main types of payment instrument.

Payment instruments in more detail

(i) *cheques*

A cheque is a debit-based instrument in the form of a written order to pay a specified sum on demand when the instrument is presented to the issuing institution (the payer's bank). It is very popular in Canada, France, the UK and the USA (see Table 2 below). Its popularity is partly a reflection of its adaptability - it can be used in a variety of circumstances, from 'point of sale' transactions (eg in shops) to a range of 'remote' transactions (eg payment of suppliers' bills).

Cheques are popular from the payer's point of view because of the delay between the drawing of the cheque and the debiting of the payer's bank account. Indeed, this feature can be deliberately used by enterprises to improve their management of cash flow.

However, as with all debit-based instruments, there is the potential problem of the credit-worthiness of the drawer of the cheque (the person making the payment): what guarantee does the receiving customer have that the cheque which he has received will represent good value - ie that the payer has funds in his bank account to back the cheque? There are a number of ways of approaching this problem:

(a) *cheque guarantee cards* In a number of countries, banks have developed cheque guarantee schemes to improve the acceptability of cheques. Cheques are supported by a plastic card (a cheque guarantee card) which is issued by a bank to its customers and which, when presented along with the cheque, gives assurance to the receiver (usually a shopkeeper) that the cheque will be honoured (up to a specified amount) by the payer's bank.

Table 2: RELATIVE IMPORTANCE OF CASHLESS PAYMENT INSTRUMENTS - by number of transactions

(1994 data: % of total number of transactions)

	Cheques	Credit transfers	Direct debits	Payment cards
BELGIUM	12	61	9	18
CANADA	53	6	6	35
FRANCE	47	16	12	16
GERMANY	8	49	40	3
ITALY	34	47	5	5
NETHERLANDS	6	64	22	8
SWEDEN	-	82	6	12
SWITZERLAND	3	78	3	16
UK	40	20	17	23
US	78	2	1	19

In some cases the total may not sum to 100% because of other items.
Source: Bank for International Settlements: "Statistics on Payment Systems in the Group of Ten countries".
Data for Japan not available.

(b) *the cheque as a pre-paid instrument* Bank customers can be issued with cheques which they have, in effect, already paid for, by having a specified sum debited to their account in advance. The travellers' cheque and the banker's draft are examples of such pre-paid cheques. The receiving customer can accept such instruments as payment in the certain knowledge that they will be honoured (provided the issuing bank is itself sound). However, the paying customer can no longer benefit from the delay mentioned earlier.

(c) *regulation* Paying customers may also be discouraged from issuing cheques that will subsequently be dishonoured, by making such practices illegal - with fines (and even the possibility of a prison sentence) for offenders. Alternatively, customers could have their cheque books confiscated and their right to use cheques suspended for a specified period.

(iii)*credit transfers*

Credit transfers (or giro payments as they are frequently called) are the traditional means of non-cash payment in a number of European countries - including Belgium, Germany, the Netherlands, Sweden and Switzerland (see Table 2). They can be in paper or electronic form and can be used for both non-recurring and recurring (eg weekly, monthly, quarterly) payments; they are not, however, suitable for 'point-of-sale' transactions.

A particular advantage of credit transfers is that the receiving customer does not have to worry about the credit-worthiness of the payer since, by definition, a credit transfer cannot be sent without the approval of the paying customer's bank, and without the paying customer's account having first been debited. (So, as with a pre-paid cheque or banker's draft, certainty of payment for the receiving customer is at the expense of the paying customer in terms of immediate debiting of his account.)

Customers who need to make recurring payments (for example payment of household mortgages, insurance premiums etc.) can enter into a standing order arrangement with their bank, which then contracts to carry out the necessary credit transfers on a regular specified data, to a specified customer and for a specified amount. Corporate customers can similarly arrange for regular payments to be made (eg wages and salaries) under a direct credit arrangement.

Customers needing to make (or receive) time-critical and/or high-value payments may use an electronic credit transfer. Not only does it provide greater certainty of payment for the receiving customer but it may also provide him with funds on the same day that the payer initiated the transfer. Indeed, in terms of the total value of payments, rather than the number of transactions, the dominance of the electronic credit transfer is readily apparent - see Table 3.

Table 3: RELATIVE IMPORTANCE OF CASHLESS PAYMENT INSTRUMENTS - by value

(1994 data; % of total value)

		Credit transfers			
	Cheques	Electronic	Paper	Direct debits	Payment cards
BELGIUM	5	25	69	1	. .
CANADA	99	1	. .	. .	. .
FRANCE	4	37	57	1	. .
GERMANY	2	73	23	2	. .
ITALY	5	85	9	. .	. .
NETHERLANDS	. .	99	. .	1	. .
SWEDEN	. .	66	30	3	1
SWITZERLAND	. .	100	. .	. .	. .
UK	8	89	2	1	. .
US	12	87	. .	1	. .

In some cases the total may not sum to 100% because of rounding.
Source: Bank for International Settlements: "Statistics on Payment Systems in the Group of Ten countries".
Data for Japan not available.
. . signifies nil or less than 0.5%.

(iii) *direct debits*

A direct debit is an instrument specifically developed to facilitate recurring customer payments, and like a standing order, is well-suited to automation. It is becoming of increasing importance in a number of countries - thus far, it is most popular in Germany and the Netherlands (see Table 2 above). Direct debit payments are pre-authorised by the paying customer, who gives permission for his bank to debit his account upon receipt of instructions initiated by the receiving customer (eg a utility company, or insurance company).

(iv) *payment cards*

The basic choice here is between credit cards and debit cards. A credit card indicates that the holder has been granted a line of credit by the card-issuing bank, enabling the holder to make purchases up to a pre-arranged ceiling. Credit thus granted can be settled in full by the end of a specified period; or can be settled in part, with the balance taken as extended credit on which interest is charged. Travel and entertainment cards (charge cards) operate on a similar principle, except that the card holder is not given the opportunity to have a period of extended credit, the full amount of the outstanding debt having to be settled at the end of the specified period.

A debit card enables the holder to have his expenditure directly charged to his bank account. It does not offer a period of free credit to the holder after he has made a purchase; but it is seen by many as a more convenient alternative to writing a cheque for a 'point-of-sale' purchase.

Both debit and credit card systems may incorporate authorisation procedures, whereby merchants at the point-of-sale obtain the approval (increasingly by on-line electronic means) of the card issuer to accept the transaction.

A third kind of payment card that is now being developed is the pre-paid card. This is a card incorporating a computer chip/integrated circuit on which value is "loaded", either from the card-holder's bank account or in return for cash. Value is then removed from the card as purchases are made, using special point-of-sale terminals. Single-purpose, non-reusable prepaid cards have been in existence for a number of years, for use in telephone kiosks and car parks for example. The new generation of cards will be multi-purpose, and rechargeable.

Payment cards may also incorporate non-payment functions. Specifically, they may be used as a cheque guarantee card (as discussed above), or as an ATM/cash dispenser card.

3 The processes of clearing and settlement in payment systems

Having looked in the previous section at the various means by which a payment can be initiated, this section examines what then happens to that payment instruction - how it is exchanged between the sending and receiving banks; and how those banks settle up between themselves so that the crediting of the receiving customer's account in final funds can take place.

Bilateral correspondent arrangements

The simplest arrangement for clearing and settlement is for the two banks concerned to establish a bilateral correspondent relationship, whereby each bank holds an account with the other (a system of 'nostro / vostro' accounts).

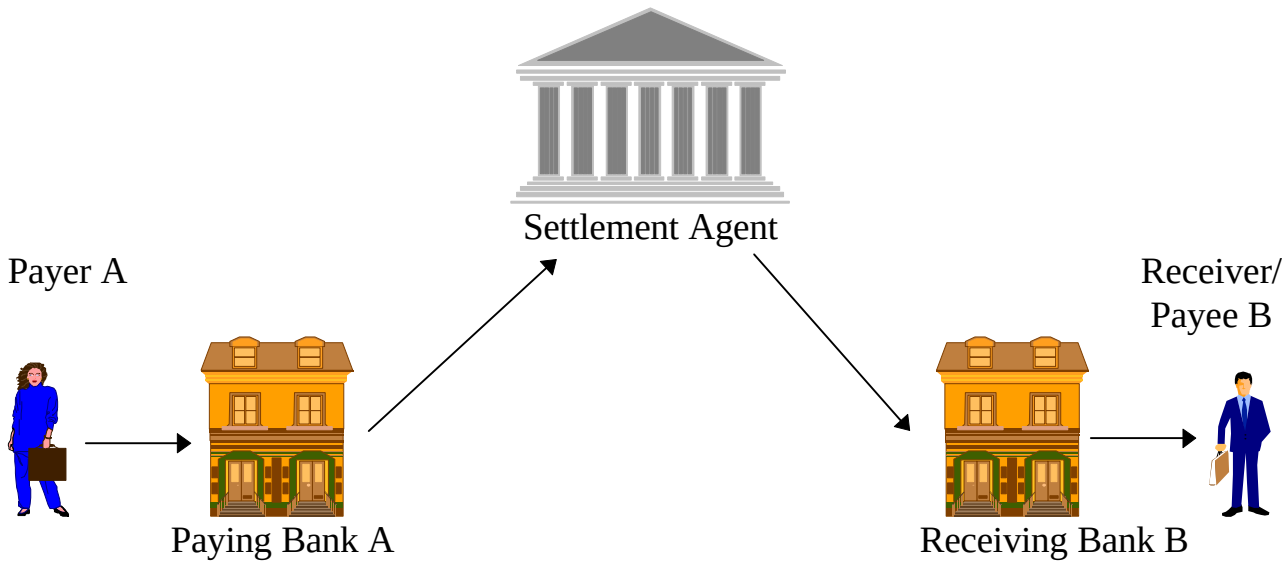
Diagram 2: BILATERAL CORRESPONDENT PAYMENT ARRANGEMENT

In terms of the diagram above, Payer A will see her account balance at Bank A fall and Receiver B will see his account balance rise as a result of the transfer of funds. For the two banks concerned, having exchanged the payment instruction, there are two possibilities: either Bank A increases the balances on the account that Bank B holds with it, or Bank B decreases the balances on the account that Bank A holds with it. (The choice will depend on whether or not Bank B wishes to hold increased balances with Bank A. If it does not, then Bank B will choose the second alternative.)

Settlement agents

Rather than hold their settlement balances in a system of mutual nostro/vostro accounts, the banks may prefer to settle with each other across accounts they hold with a third party, a settlement agent, which may be either another commercial entity or, as is most often the case, the central bank. (For the remainder of this section, it will be assumed that the settlement agent is the central bank.) So, in terms of the present example, Bank A's balances at the central bank are reduced, and Bank B's balances are increased.

Diagram 3: THE ROLE OF THE SETTLEMENT AGENT



Gross versus net settlement

Having considered *where* interbank settlement takes place, there is then the question of *how often* settlement should take place: the number and timing of settlement account entries.

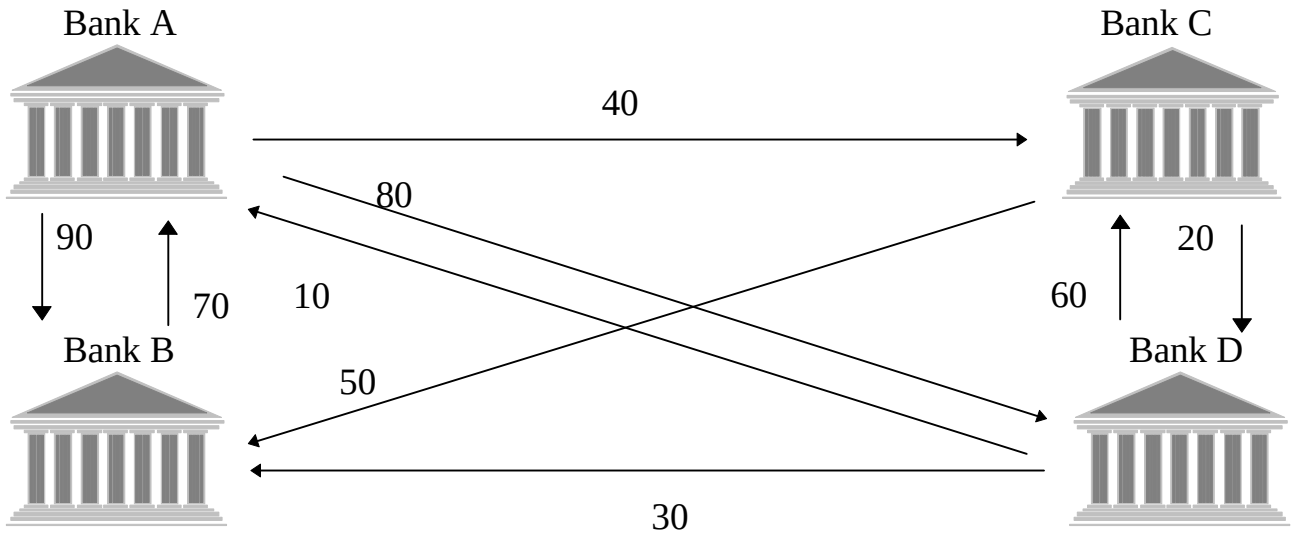
With *gross settlement*, each payment instruction is passed from the paying bank to the central bank and is individually settled across the accounts of the paying and receiving banks. Thus, there will be a debit and credit entry for each and every payment instruction settled.

In contrast, with *net settlement* the number of settlement account entries is reduced by the process of netting each bank's out-payments against its in-payments before settlement takes place.

The arithmetic of net settlement

The netting procedure can be considered in two stages, either of which may form the basis for producing the entries for posting to settlement accounts. This will be illustrated with a hypothetical four-bank payment system in which the banks are exchanging payment instructions. These are shown in Diagram 4 below.

Diagram 4: PAYMENT FLOWS WITH GROSS SETTLEMENT

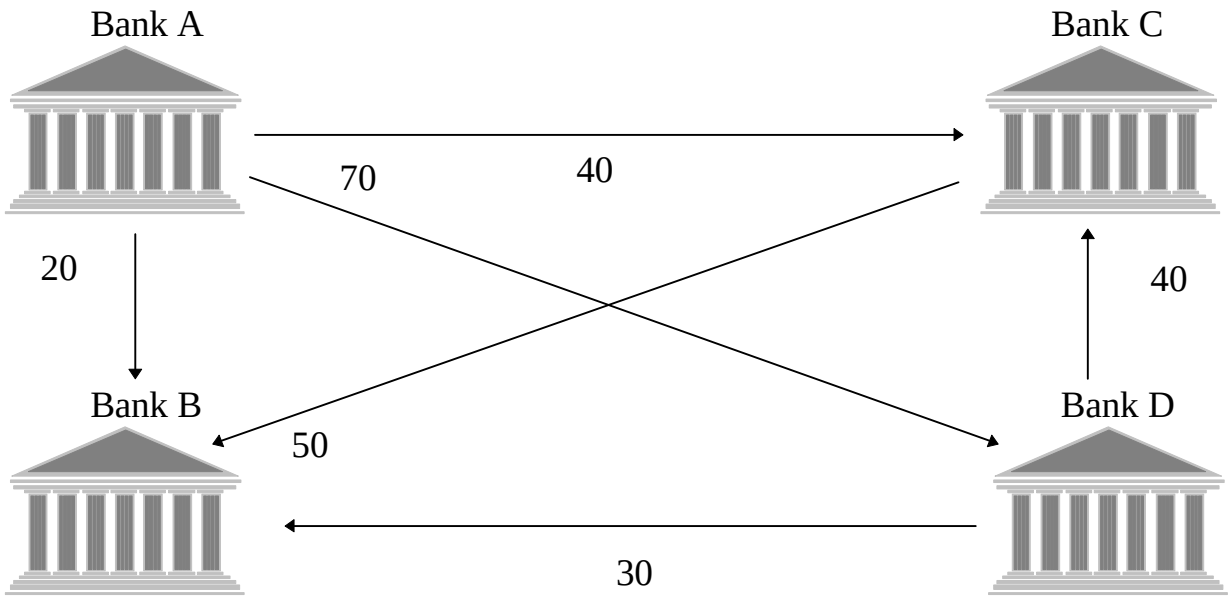


In the illustration, payment instructions flow in both directions between some pairs of banks (eg between Bank A and Bank B), but only in one direction for other pairs (eg between Bank B and Bank D). With gross settlement, each individual payment will be settled across the central bank settlement accounts.

Bilateral netting involves the offsetting of the bilateral claims and obligations between each pair of banks. In the four-bank example this

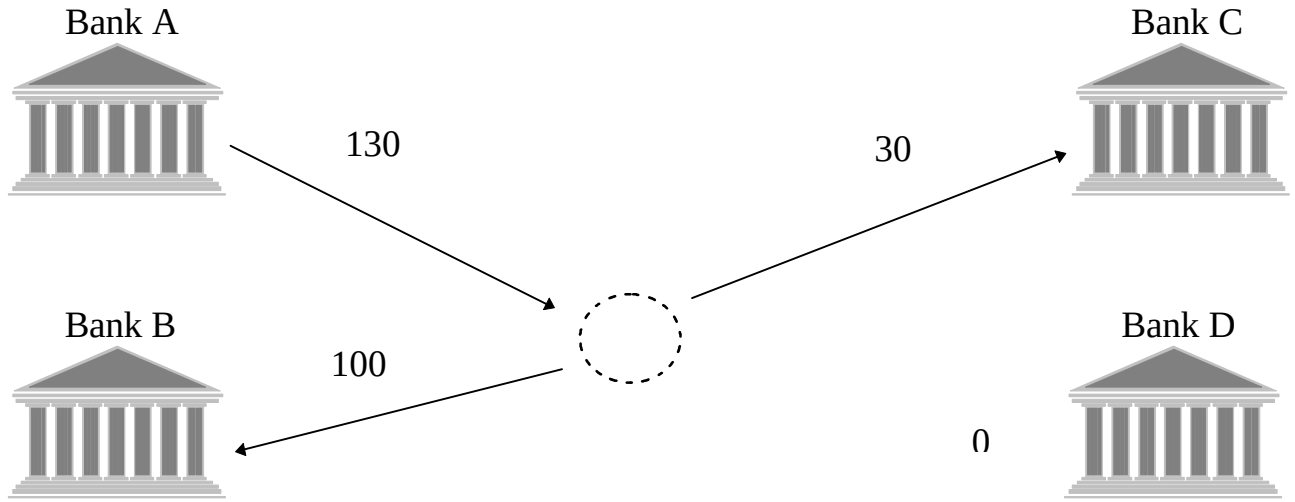
means that each bank will have three separate bilateral positions with respect to the other members of the system - positions that can be either a 'net pay' or a 'net receive', or a zero net obligation (though this last possibility is not included in the example). Thus in the next diagram, Bank A is a net payer to all three other banks; while Bank D is a net receiver from A, but a net payer to B and C. These bilateral net positions may be used instead of the gross figures for the interbank settlement.

Diagram 5: BILATERAL NET SETTLEMENT



The second, and ultimate, stage in the netting process is *multilateral net settlement*, whereby each bank in the system settles its overall net position with respect to all the other members of the system. There will only be one settlement account entry for each bank. This is shown in Diagram 6.

Diagram 6: MULTILATERAL NET SETTLEMENT



Under multilateral net settlement, Bank A is a net payer, Banks B and C are net receivers, while Bank D has a zero net position. This whole process can be presented in tabular form in a *settlement matrix* (Table 4): this shows all the gross payments between pairs of banks and how the ultimate multilateral net positions are derived.

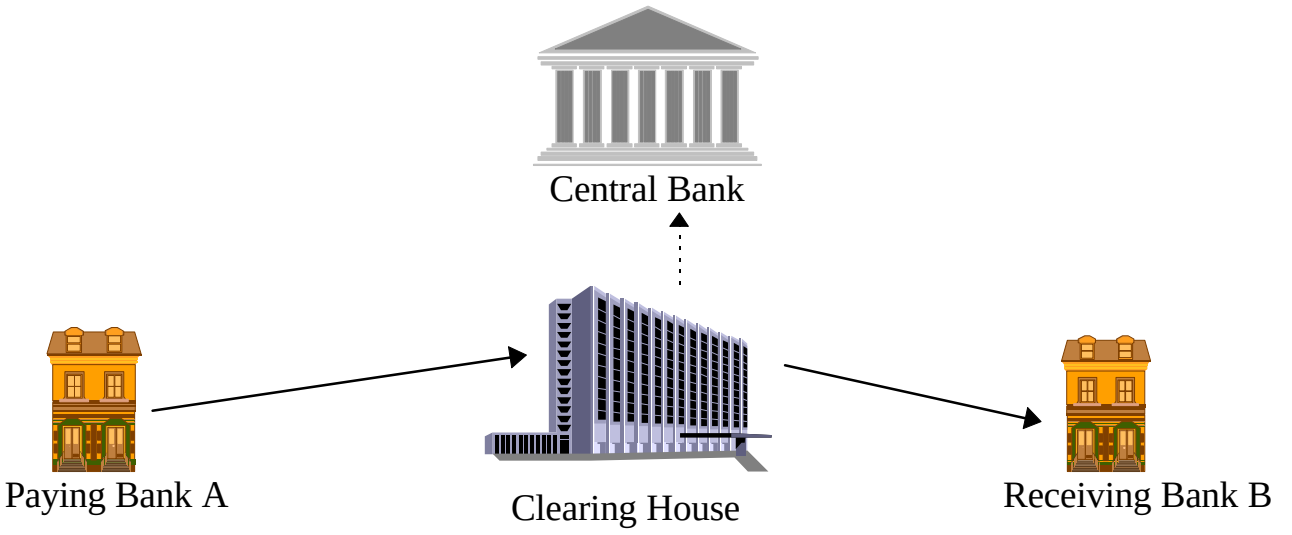
Table 4: A SETTLEMENT MATRIX

Bank sending payment	Bank receiving payment				Sum of obligations
	A	B	C	D	
A	-	90	40	80	210
B	70	-	0	0	70
C	0	50	-	20	70
D	10	30	60	-	100
Sum of claims	80	170	100	100	450
Sum of obligations	210	70	70	100	450
Multilateral net positions	-130	100	30	0	0

Payment systems with multilateral net settlement usually operate through a *clearing house*, a central location through which the payment instructions pass and which is responsible for calculating the multilateral net positions of the member banks and passing them on to the central bank for posting to the members' settlement accounts.

This leads naturally onto the question of the *timing* of settlement. A netting operation requires the collecting together of details of in- and out-payments submitted over a specified time period - often a whole business day, although it may involve shorter, more frequent periods. There is thus a *delay* between the initial submission of the payment instruction and the settlement across the accounts at the central bank. Indeed, it may be the case that payment instructions pass through the clearing house and on to the receiving banks *before* settlement takes place. This has important implications for the risks in payment systems, which will be examined later.

Diagram 7: THE ROLE OF THE CLEARING HOUSE



Settlement is also delayed in gross settlement systems if the actual posting to accounts is carried out on a batch basis. However, increasingly, electronic gross settlement systems are able to provide *real-time* settlement, ie settlement of payment instructions as soon as they are submitted by the paying bank.

Clearing houses

Payment system clearing houses can take a variety of forms.

- They may be owned and operated by the central bank itself, or by the commercial banks, or by a combination of the two.

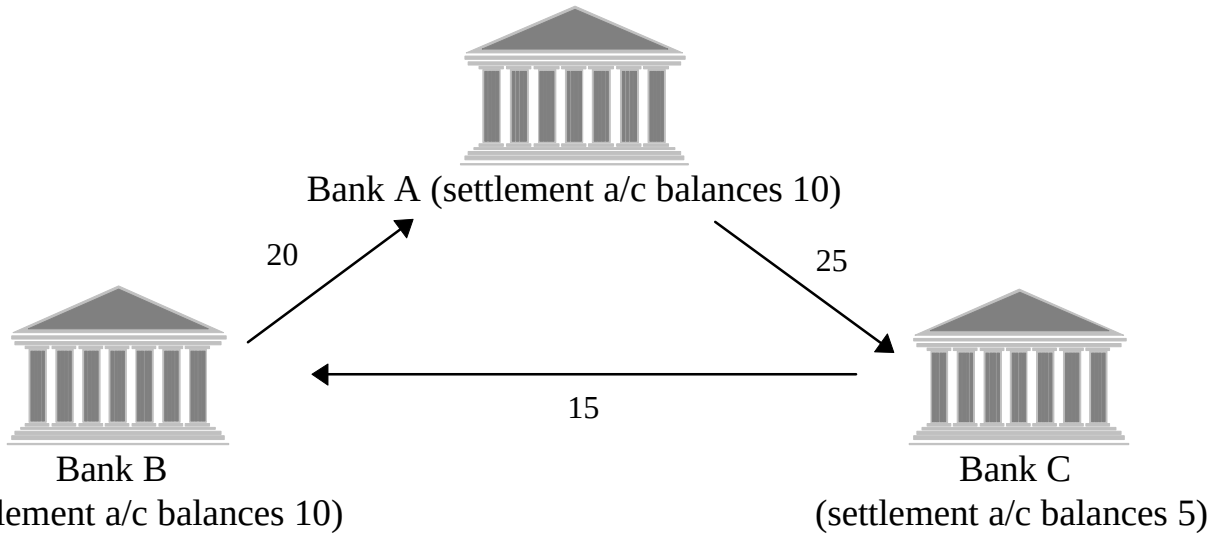
- They may be designed to handle either paper or electronic/automated payment instructions, or both. With electronic payments, the clearing house may process them in batches, or in real-time as each instruction arrives. The latter alternative enables the clearing house to monitor banks' net positions on a continuous basis - important if there is a structure of limits in place (see next section).

- They may be organised to serve the whole country, or on a regional basis within the country. The latter may be useful in countries with poor communications and transport infrastructure, or where there are large distances between centres of population and activity. In such cases, the settlement accounts of the banks in the regional/local clearing house may be held at the local branch of the central bank.

Liquidity requirements for gross and net settlement

A particular advantage, as far as commercial banks are concerned, of net settlement over gross settlement is the lower level of settlement account balances that net settlement procedures require in order to successfully process a particular volume of payment business. This can be illustrated by the very simple example in Diagram 8 and Table 5.

Diagram 8: AN ILLUSTRATION OF "GRIDLOCK"



If in the 3-bank, 3 payment example above, settlement is on a gross basis, then no bank has sufficient liquidity available to cover the payment that it wishes to make - and the settlement agent is likely to reject all the payment requests. The system therefore faces a situation of "gridlock": for any individual bank, no outgoing payment can be made because the incoming payment is also held up. However, if the same three banks, with the same payments and the same levels of liquidity/settlement account balances, were involved in a multilateral net settlement arrangement, then the problem disappears. Looked at in terms of a (very simple) settlement matrix, we would have the following situation:

TABLE 5: AVOIDING "GRIDLOCK" USING NET SETTLEMENT

Bank making payment	Bank receiving payment A	B	C	Sum of obligations
A	-	0	25	25
B	20	-	0	20
C	0	15	-	15
Sums of claims	20	15	25	60
Multilateral net position	-5	-5	10	0
Liquidity	10	10	5	

So, both Banks A and B have sufficient liquidity to meet their 'net pay' obligations, while Bank C is in a 'net receive' position anyway. This ability to economise on settlement account balances is obviously attractive to commercial banks - given that such balances do not normally attract any interest.

Historically, payment systems with net settlement arrangements were very much the norm in developed market economies. However, the following chapter will focus on the risks that can arise in such arrangements - particularly when they are handling high-value payments.

4 Settlement risk in payment systems

This section and the next examine the major risks in the operation of payment systems. These fall into two broad categories - financial risks and operating risks - both of which have the potential to be a source of systemic disturbance. This section will examine the financial risks - and most particularly the risk of a commercial bank failing to meet its settlement obligations: settlement risk.

Customer credit risk and settlement agent risk

Two particular kinds of financial risk have already been referred to earlier: customer credit risk and settlement agent risk.

Customer credit risk has two aspects. First, there is the risk generated when a bank allows a customer to make a non-cash payment when that customer does not have sufficient funds on his bank account. This may arise because the customer has assured his bank that sufficient funds will be coming into his account later on that same day; or it may simply reflect a decision by the bank to give the customer an overdraft. Secondly, customer credit risk arises when one counterparty accepts a debit transfer instrument, such as a cheque, from another counterparty in exchange for goods or services - the risk being that the cheque will not be

honoured. Whatever its origin, the risk is generated following a decision based on commercial judgement and experience and, as such, is not a risk specifically arising from the operation of the payment system.

Settlement agent risk refers to the risk that the settlement agent serving a payment system may fail. This could lead to the cancellation of all customer and inter-bank payments processed since the previous settlement was completed, as well as the loss of the existing settlement balances held with that agent by the member banks of the system - both events of potential systemic importance. Since this risk can only arise in situations where the settlement agent is other than the central bank, it is clearly important that, if such arrangements are to be allowed, the central bank should have in place a sufficiently rigorous oversight regime so as to minimise the likelihood of a failure. In the remainder of this section, however, it is assumed that the central bank *does* act as the settlement agent.

Settlement risk in payment systems - what is it and how does it arise?

Settlement risk is fundamentally a problem of delayed settlement - the delay between the passing of the payment instruction from sending bank to receiving bank and the settlement between those two banks, typically on a net end-of-day basis. It is a risk relating to a failure on the part of a bank to meet its settlement obligations, and may manifest itself in two ways:

- liquidity risk. This is the risk that if one bank fails, for whatever reason, to meet its net settlement obligation when due, then the other banks in the system will receive less in the settlement (or have to pay more) than they had been expecting. The surviving banks may as a result have to raise additional funds at very short notice in order to cover their settlement obligations - particularly if, as is likely, they normally manage their settlement accounts so that balances are kept to a minimum. Failure to secure the additional late funding which is required may trigger a second round of problems.

- credit risk. This risk arises when a receiving bank makes the proceeds of an incoming payment instruction available to its customer on the assumption that the sending bank will be able to meet its net settlement obligation at the end of the day. If the sending bank defaults, then the receiving bank risks losing the funds it has already paid out to its customer (who may already have delivered them to somebody else).

Why is settlement risk a problem?

Net settlement is a very convenient way of organising settlement in payment systems handling large volumes of low-value payments. However, in many developed market economies, the principle has also been adopted for systems handling high-value payments. As a result the liquidity risks and credit risks in such systems have become very large; often they may not be controlled satisfactorily, but the banks operating in such systems frequently assume that the central bank would resolve any settlement risk problem at the end of the day - in other words, that the central bank would, implicitly if not explicitly, guarantee the final settlement.

Central banks reject any suggestion that they (and ultimately the taxpayer) should provide such a guarantee - it is not an appropriate use of public funds. Instead, they are pressing for payment systems to be redesigned so as to reduce risks, and ensure that, where risks remain, system members have the capability and incentives to manage such risks.

Possible ways of addressing settlement risk in net settlement systems

(a) delay the availability of funds to the final customer - ie until the interbank settlement has taken place. In theory, this would have the effect of removing the credit risk from the system (though it does not address the liquidity risk problem). However, in practice it is not a very realistic basis for operating large-value payment systems where, increasingly, customers will demand same-day value - which, in an end-of-day net settlement system, inevitably means making funds available before settlement.

(b) restricting membership of the payment system - ie to those banks who might be least expected to default on a settlement obligation. The problem here is how to define such a group. It would clearly be unfair to base the membership simply on balance sheet size, for example. Some allowance would need to be made for other factors, such as the amount of capital, or the amount of liquid assets held. Whatever the criteria, they would need to be publicly disclosed and would therefore have to be seen as objective and non-discriminatory. Even so, no form of restricted membership could entirely guarantee against a default occurring.

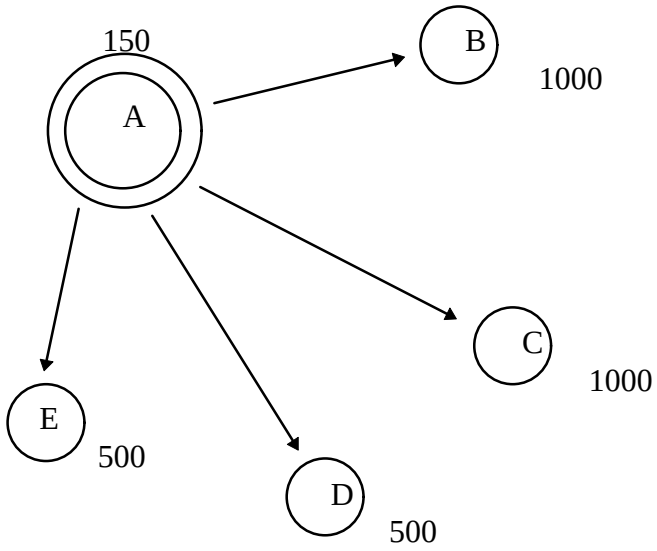
(c) caps/limits on intra-day exposures - ie apply to the payment systems a technique that banks use to control counterparty risk in other markets (such as the money or foreign exchange markets). Thus, if a bank attempts to send a payment which results in that bank breaching the limits set for it within the system, then that payment will be rejected, or will join a queue and be released as and when there is sufficient room within the limits structure. Limits are basically of two kinds:

- bilateral net receiver limits. These are limits set by each bank in the system on every other individual bank in the system, and define the maximum intra-day *net* credit positions that a bank is prepared to have with respect to those other banks. The size of each individual limit will reflect the assessment made of the other bank's creditworthiness. Thus, if sending Bank A has a payment rejected/queued because it breaks the receiver limit set by receiving Bank B, then that payment can only be released once a sufficient payment (or payments) has passed in the opposition direction (ie from B to A), thereby reducing Bank B's bilateral net exposure to Bank A.

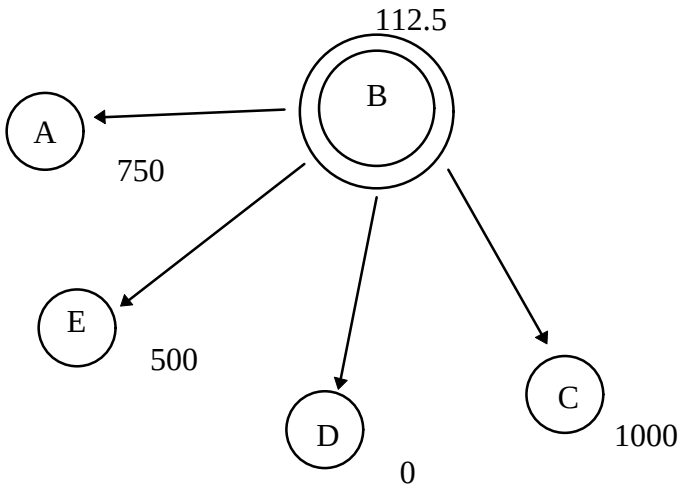
- system-wide net sender debit limits. These are limits set centrally in the payment system, placing a limit on the aggregate net debit position that a bank may have with the rest of the members as a whole. It is often related arithmetically to the bilateral net credit limits - in the illustration in Diagram 9, each bank's net sender debit limit is set at 5% of the sum of all the bilateral credit limits set against it by the other banks in the system.

Diagram 9: BILATERAL RECEIVER AND NET SENDER LIMITS

Bank A's limit structure



Bank B's limit structure



Key:

net sender limit for that bank

bilateral net receiver limit set by that bank

To operate and police a system of limits requires an electronic transfer system with real-time (rather than batch) processing of payment instructions. More importantly, the limitations of any such system should be recognised:

◊ by definition, they leave a certain amount of intra-day exposure in the system. In the event of a settlement default, can the central bank and the commercial banks be sure that the limits structure has reduced the problem to manageable, non-systemic, proportions? One solution here is to have all exposures fully-covered by collateral, so that in the event of a settlement default, the defaulting bank's collateral assets can be quickly used to generate the necessary 'missing' liquidity.

◊ the effectiveness of a limits structure in even containing the settlement risk problem may tend to be eroded over time. Pressure from customers, who dislike having their incoming payments delayed, may lead to the setting of limits at accommodating, rather than prudent, levels. A bank which does not respond to such pressure may eventually lose customers to its competitors.

(d) liquidity-sharing and loss-sharing agreements. These will normally be operated in conjunction with a system of limits, and aim to provide *some* assurance that, if a settlement failure occurs within the limits structure, the necessary funds will be forthcoming so that the settlement can be completed. Basically, it will be the 'surviving' members of the clearing house who will together meet the liquidity shortfall, according to some agreed formula. How could the shortfall be shared out?

- <u>equal shares amongst the survivors</u>. This is the simplest formula, but is also the least fair, taking no account of the existence or otherwise of counterparty relationships between individual surviving banks and the failed bank.

- <u>losses shared pro-rata according to the actual bilateral exposures to the failed bank</u>. This seems fairer - but fails to recognise the passive/involuntary nature of many payment system exposures: the fact that a surviving bank has the largest exposure to the failed bank may simply reflect a particular pattern of customer payment flows,

beyond the control of either bank. Should that surviving bank therefore be made to bear the burden of the loss-sharing?

- losses shared pro-rata to the bilateral limits each surviving bank had set against the failed bank. This is probably the most equitable method of sharing out the loss amongst the surviving banks - according to their prior individual assessments of the failed member's creditworthiness.

However, loss-sharing agreements carry their own risks. First, such schemes are unlikely to eliminate settlement risk completely, and so may create a sense of undue complacency amongst the system's member banks. Second, the additional settlement obligations which arise for the members when a loss-sharing agreement has been activated could themselves, if not anticipated or somehow allowed for in advance, lead to a second round of settlement failures - eg if a bank, which had previously only just enough liquidity to cover its original obligations, was now being called upon to provide an additional amount of funding in excess of its liquid resources.

(e) "Unwind" and recalculation of the net positions. One further method for resolving a settlement problem, which is practised in a number of clearing houses, involves removing the failed bank from the day's settlement altogether and re-calculating the net settlement positions excluding payments to and from that failed bank. However, such a measure - involving the cancellation of all the affected payments - could have major repercussions amongst the customers of both the failed bank and the surviving banks, and could quite possibly trigger defaults among those customers, creating the sort of financial market instability and uncertainty that central banks are so keen to avoid. More directly, the process of excluding one bank from the net settlement calculations can transform the settlement obligations of the other banks, and create unexpected liquidity shortfalls for other members which they in turn may not be able to fund. Tables 6 and 7 illustrate how such a domino effect could get underway through the use of an "unwind" procedure, and show why central banks have concluded that reliance on this procedure is no longer an acceptable approach to the management of payment system risk.

In the settlement matrix illustrated in Table 6, three of the six banks in the system have 'net pay' positions after the end-of-day calculation, with Bank B unable to cover its position from available sources of liquidity (such as liquid balances, readily marketable assets, or lines of credit from other banks).

Table 6: THE POSSIBLE EFFECTS OF AN "UNWIND" MECHANISM: THE ORIGINAL SETTLEMENT MATRIX

Bank making Payment	Bank receiving payment						Sum of Obligations
	A	B	C	D	E	F	
A		200	900	700	2200	500	4500
B	400		600	1250	300	950	3500
C	400	600		300	750	400	2450
D	900	350	400		150	200	2000
E	750	150	800	1500		650	3850
F	1500	500	450	550	550		3550
Sum of claims	3950	1800	3150	4300	3950	2700	19850
Multilateral net position	-550	-1700	700	2300	100	-850	0
Liquidity available	950	850	500	800	350	950	

Excluding Bank B from the matrix and recalculating the net positions produces the results shown in Table 7.

Following the recalculation, Bank F now has a 'net pay' position that it cannot cover from its available liquid resources. Continuing this procedure, by excluding Bank F and recalculating, the problem passes to Bank A, and so on. This unravelling of the settlement matrix is not an inevitable outcome of an "unwind" procedure, as it will depend on the particular pattern of the payment flows and resulting net positions; however, the risk that it might happen makes the use of such a procedure very unattractive, particularly if the clearing arrangement is handling high-value payments.

Table 7: THE SETTLEMENT MATRIX, EXCLUDING BANK B

Bank making payment	Bank receiving payment						Sum of obligations
	A	B	C	D	E	F	
A			900	700	2200	500	4300
B							
C	400			300	750	400	1850
D	900		400		150	200	1650
E	750		800	1500		650	3700
F	1500		450	550	550		3050
Sum of claims	3550		2550	3050	3650	1750	14550
Multilateral net position	-750		700	1400	-50	-1300	0
Liquidity available	950		500	800	350	950	

The legal validity of the netting calculations in net settlement systems

Quite apart from the credit and liquidity risks that are inherent in payment systems with net settlement, there is also a risk attached to the netting process itself. While calculating the net amounts due between the member banks is easy enough, difficulties may well arise in ensuring that, in the event of one bank defaulting, those net amounts represent the real - ie legal - obligations or claims of the remaining banks. The danger is that a liquidator, appointed to sort out the bank's financial affairs after it has failed, will challenge the netting procedure, claiming that it is the underlying gross payment flows that are the real obligations. If such a challenge was successful, the remaining banks in the system would first of all be required to settle with the liquidator all the gross amounts *due to* the failed bank, and only later would those banks be compensated (and not necessarily in full) for the gross amounts that they should have received *from* the failed bank. This "unpicking" of the netting calculation could itself create severe financial pressures amongst the remaining banks, some of whom would have been expecting to be net recipients in the settlement and would have organised themselves accordingly but who would now be faced with immediate claims for funds from the liquidator.

Depending on the particular legal framework that exists in a country, it may be possible to make laws and regulations that protect netting arrangements in the event of a bank failure/insolvency. However, this is not always the case, and for many central banks the uncertainties surrounding the legal validity of netting has been an important additional reason why they are now seeking to develop real time gross settlement systems to handle high-value payments.

Real-time gross settlement

In payment systems that incorporate real time gross settlement (RTGS), individual payments are settled across the settlement accounts of the commercial banks at the central bank as they progress from the sending bank to the receiving bank. Thus, the problem of interbank credit risk is removed from the operation of the payment system: on receiving an incoming payment instruction, the receiving bank knows that the amount involved has already been settled in final, central bank, funds and can be immediately credited to the ultimate beneficiary's account.

RTGS systems have been in place, for example in the United States (the Fedwire system) and in Switzerland (the SIC system), for a number of years. Most other developed market economies are now in the process of introducing them. In the European Union, the central banks have agreed that each member state should develop a domestic RTGS payment system as the premier system for handling large-value, same-day payments, and as a component in the pan-European same-day payment system required under European Monetary Union.

However, whilst RTGS removes *interbank* settlement risk from the payment system, it does raise some important issues for both central bank and commercial banks concerning the provision of liquidity. Under payment systems with net settlement, the liquidity needed to ensure the smooth flow of payments through the day is provided by the implicit granting of intra-day credit by the receiving banks to the sending banks. Under RTGS, this intra-day credit between the commercial banks disappears. How is the necessary liquidity under RTGS to be provided? There are a number of options:

(i) *provide no additional liquidity*. This is the strictest RTGS model, in which a payment will only be settled (and then passed on to the receiving bank) if the sending bank has sufficient balances on his settlement account. If there are insufficient balances, then the payment is rejected or joins a queue. The Swiss SIC system is an example of a system which works on this principle.

(ii) *allow overdrafts on settlement accounts*. This reintroduces intra-day credit to the payment system, but its provision by the central bank is explicit and on specified terms relating, for example, to:

- maximum permitted limits on any overdrafts;
- whether or not overdrafts have to be secured, fully or in part, by collateral;
- whether there is an interest charge.

Thus, in the United States, the Fedwire system allows uncovered intra-day overdrafts up to a limit, but with interest charged on the level of the overdrafts through the day.

(iii) *provide a liquidity management mechanism, such as a same-day sale-and-repurchase ('repo') facility*. Under such an arrangement, the central bank will agree to purchase particular kinds of highly liquid and marketable assets from the commercial banks and credit their settlement accounts with the proceeds, with the transaction automatically reversed (and the settlement account debited) at the end of the business day. Such an arrangement has been developed for the RTGS system now operating in the United Kingdom.

A key element in such options (except in the case of unsecured overdrafts) is that each commercial bank has to decide for itself how much liquidity it requires, and then has to provide the appropriate amount of securities or hold the appropriate cash balance on its account with the central bank.

The introduction of a real-time gross settlement system raises some other interesting and important issues, both for the commercial banks and the central bank:

- *management of payment traffic*. Whichever RTGS model is adopted, it becomes very important for commercial banks to manage effectively their, and their customers', payment traffic through the system. By scheduling out-payments through the day, a bank will be able to minimise the risk of payment instructions being queued or rejected; and will be able to minimise the liquidity (in the form of high-quality assets which are accepted by the central bank as collateral or for use in same-day repo operations) that has to be devoted to the system.

- *direct membership of RTGS*. Restricted membership was earlier mentioned as one possible way of containing interbank risk in payment systems with net settlement. In an RTGS environment, with interbank risks removed, the case for such restrictions is very much reduced.

- *central bank/commercial bank relationship within the payment system*. Again, the change from a net settlement/clearing house environment to RTGS alters the relationship between the central bank and the commercial banks within the payment system. Simply from an operational viewpoint, RTGS involves the central bank in clearing and settling each individual payment instruction, rather than just settling one set of multilateral net figures at the end of the day.

- *RTGS as an important element in financial market development*. The introduction of RTGS for high-value, time-critical payments is an important element to establishing safe and effective settlement arrangements in an economy's financial markets. This will both increase the effectiveness of market-based monetary operations by the central bank, and more generally can help reduce the likelihood of a systemic disturbance in the financial economy.

5 The legal and technical environment for payment systems

The legal environment

For a payment system to operate effectively, it must have rules governing the rights and responsibilities of the various parties involved in the payment process, both under normal operating conditions and when something goes wrong during that process. This is particularly important given the continuing shift from paper-based systems to various forms of electronic funds transfer, where the status and location of a particular payment instruction at a particular point in time becomes less obvious, more difficult to define.

Once again, there is no single, ideal way in which this legal framework should be organised. At one end of the spectrum, the framework can have a statutory basis, with the rights and obligations governed by national or federal law. In such a situation, it may be that the central bank will have the power to issue regulations governing the operation of payment systems which have ultimate statutory backing. At the opposite end of the spectrum, the legal framework may have little or no specific statutory support, relying instead on a mixture of written or implicit contracts between the parties concerned. The reality in any particular country may well be somewhere between these two extremes. Advocates of a statutory approach will point to the degree of clarity and certainty that it can provide. Those who favour a non-statutory approach will emphasise its flexibility and adaptability to changing circumstances.

Whatever the legal approach adopted, the framework once established needs to have addressed a number of key questions:

(1) *the scope of the law*. Which parties and what specific category of instructions are governed by a particular rule or regulation?

(2) *when are the rights and obligations of the parties to a funds transfer 'triggered'*? At what point in the payment process does a party gain some legal entitlement, or become legally responsible for performing certain duties? For example, at what precise moment does a

receiving bank become legally responsible for crediting the receiving customer's account?

(3) *when is a payment final and irrevocable?* When does the receiving customer know that he has received "good funds" into his bank account, and that the transfer of funds cannot be reversed?

(4) *who is responsible if a funds transfer is not completed?* What are the respective rights of the sending customer and his bank, and the receiving customer and his bank?

(5) *how is liability in the event of a fraudulent transfer of funds to be decided?* Has the fraud been the result of negligence on the part of any of the parties to the funds transfer, and how is that negligence defined? If all parties acted in good faith, who is to bear the loss?

(6) *what are the consequences of a bank failure within a payment system?* How do the provisions of insolvency law apply to the operation of the payment systems, particularly of systems with net settlement arrangements? (This issue was discussed above.)

In establishing the legal framework for a country's payment systems, the following points may be noted:

- the laws which are established must carefully balance the needs and concerns of the customers who use the payment systems and of the commercial banks (and central bank) which operate the system. Customer confidence that the balance struck is an equitable one, particularly as regards the rights and obligations within electronic (and card-based) funds transfer systems, can be promoted through the adoption and publication by the commercial banks of a code of conduct. In some countries, such codes have been given statutory backing.

- a payment system's internal operating rules and procedures can form an important element within the overall legal framework, and may very well be in place before full and comprehensive statutes and regulations have been drafted and approved.

- whatever the form of the legal framework, it must be responsive to changing conditions, whether they are the result of technological advance or of changing preferences or practices in banking in general, and money transmission in particular.

The technical environment

The discussion so far has concentrated on risk of a financial nature, arising from the particular relationships between counterparties within the payment system. There are also a range of operational risks that can adversely effect a payment system - the risk of an interruption or intervention, deliberate or accidental, in the normal operating procedures and processes. Such risks can pose a major threat to a payment system and to the financial economy as a whole, and as such need to be carefully examined and monitored.

Human error

Perhaps the most obvious operational malfunction arises from simple human error - for example, the keying-in at a computer terminal of the wrong amount, or the wrong account number. It is perhaps a little difficult envisaging such events causing major disruption to a payment system. However, were such errors to be repeated on a regular basis, customers could lose confidence in the banks which were mis-handling the payments, and could eventually lose confidence in the particular payment instrument being used. Proper supervision of clerical staff will help minimise this risk, as will dual control procedures on electronic funds transfer systems (where the details of payment instructions have to be keyed-in twice before being released through the system).

Fraud

An unwelcome feature of the trend away from paper-based to electronic and card-based payment systems has been an increased incidence of fraud. Again, while the losses arising from fraud world-wide have not so far represented any kind of systemic threat to payment systems, customer confidence could quickly be undermined if, for

example, a particular payment instrument appeared particularly susceptible to fraud. The worst possible scenario would involve fraudulent access to a high-value payment system; so commercial banks and central banks alike must at all times monitor the security arrangements in such systems.

Fraud may be examined in terms of the physical characteristics of payment instrument being used, ie paper, plastic or electronic.

(i) *fraud involving paper instruments*. The traditional security device on a cheque is, of course, the payer's signature. In addition, cheques are usually printed on special security paper so as to deter counterfeit. Stolen cheques many not be acceptable without an accompanying guarantee card. The problem of fraudulently altered cheques can also be limited by having strict practices governing their transferability. Fraud involving paper credit transfers most frequently involves the insertion of fraudulent vouchers during the clearing process; close staff supervision will help minimise this risk.

(ii)*fraud involving plastic cards*. These continue to be a popular target for fraud. The simplest kind involves the fraudulent use of lost or stolen cards. Measures to minimise this risk include the use of photographs on cards and of personnel identification (PIN) numbers, regularly updated 'hot-card' files (giving shopkeepers details of all recently stolen or lost cards), reducing the value threshold beyond which a transaction has to be authorised, and for the future, the possibility of incorporating biometric techniques at the point-of-sale (eg fingerprints, or signature analysis). The practice of sending new cards to card-holders throughout the mail is also now discouraged, because of the risk of cards being intercepted. Individuals may also make fraudulent applications for cards. Co-operation and information exchange amongst the card-issuing banks, and between the banks and the police have helped to identify this kind of fraud. So-called merchant fraud, in which shopkeepers and merchants create false transactions and claim the proceeds, can be more difficult to detect. Finally, the cards themselves may be counterfeited. To prevent this happening, the security features built into cards are continually being up-graded (eg the addition of holograms); and with the eventual

migration from magnetic stripe to micro-chip technology, the opportunities for counterfeit should be further reduced.

(iii)*fraud in electronic payment systems*. The risk here is that false messages will be created or authentic messages fraudulently altered. Techniques such as encryption and message authentication exist to prevent unlawful access to, and then manipulation of, an electronic funds transfer system from outside. If the fraud is being attempted from within the payment system, then procedures such as restricted access to key areas and functions, dual controls and password protection will all help to minimise the risk.

If fraud in payment systems is to continue to be contained, then the processes of education (of customers in the safe use of their payment instruments) and vigilance (of both customers and operators of the payment systems) must also continue.

Technical failure

The greatest operating risk is that, for some reason, the whole payment system ceases to function, or a particular bank within the system is unable to send or receive payment instructions. Such an event could have systemic repercussions: for example if a major bank in the high-value payment system was experiencing technical difficulties in sending and receiving payments, the result could be 'gridlock' in the system.

Experience shows that it is relatively uncommon for the machinery and computer equipment within a payment system to fail. Most problems arise from some kind of external interference, such as deliberate attack, fire, natural disasters or electrical power failure. A number of precautions can be taken to reduce the risks posed by each of these. Thus, while it is very difficult to accurately anticipate a deliberate attack, security monitoring devices may deter sabotage. Again, susceptibility to natural disaster can be minimised by siting computer installations carefully. Similarly, by adopting and implementing the concept of 'uninterrupted power supplies' (UPS), an installation can be protected from loss of, or variations in, power supply. Back-up arrangements should also be in

place (at least for the most critical operations), as insurance against a main installation being completely incapacitated; and every organisation should have comprehensive, and frequently tested, disaster recovery and contingency planning procedures.

6 Payment systems and securities settlement

A developed market economy needs to be served by well functioning securities markets, on which government or private sector securities can be bought and sold. In turn, these markets need to be served by some kind of securities settlement system, which transfers securities from the seller to the buyer, and funds from the buyer to the seller. Securities settlement systems may incorporate a funds transfer mechanism as well as the securities transfer mechanism; or alternatively they may utilise an established payment system to effect the funds transfer.

Key steps in securities clearance and settlement

In order properly to understand the range of risks faced in securities settlement, it is useful first to consider the key steps in securities transactions. These are:

(1) *execution of the trade*. This may take a variety of forms, depending on the type of market (eg open outcry, or a telephone-based market).

(2) *trade matching*. This procedure ensures that the two parties to the trade agree on the terms (the price, amount etc.)

(3) *trade clearance*. This refers to the calculation of the counterparties' obligations to make deliveries of securities or to make payments on the settlement date (which will most often be at least a day or two after the date of trade execution). The calculation of both sets of obligations may be carried out on a net basis, although as regards the delivery of securities the volume of market trades may not be

sufficient and the variety of securities traded may be such that netting is not worthwhile.

(4) *transfer instructions*. Instructions for the transfer of both securities and funds must be transmitted to the settlement system.

(5) *settlement.* Settlement involves the two-way transfer of securities and funds. Historically, securities transfers involved the physical movement of certificates. However, in recent years transfers have increasingly occurred by book-entry, ie an accounting system that permits the transfer of securities without the movement of certificates, all of which remain within a central securities depository. The funds transfer mechanism may be incorporated within the central securities depository, or there may be a link between the latter and an established payment system. In some cases, most often for government securities, the central bank operates the central securities depository, while in other cases it is operated by a private entity.

Risks in securities settlement

Credit risk in securities settlement is the risk that a counterparty will not settle an obligation (to deliver either securities or funds) when due, or not even subsequently. The risk can take two forms:

- *replacement cost risk*. If a counterparty defaults on a trade before the settlement date, then the non-defaulting party may, because of movements in the market price of the security since the trade date, face loss of unrealised gains (or, in other words, may only be able to replace that trade in the market at a loss). The seller of a security is exposed to replacement cost loss if the market price is below the original contract price, while the buyer of the security is exposed to such loss if the market price is above the contract price.

- *principal risk.* This is the largest element of credit risk, and arises when a counterparty defaults on a contract on the settlement date. For the buyer of the securities it is the risk of making the payment but not receiving the securities; for the seller, it is the risk of delivering the securities but not receiving payment. In both cases, the risk for the

non-defaulting counterparty is for the full value of the securities or funds that he has delivered to the defaulter.

Both counterparties are also exposed to liquidity risk on settlement date, ie the risk that a counterparty will not settle an obligation for full value when due, but on some later date. This may happen for technical or temporary reasons, in which case it would be a failed transaction rather than a default. At the time such a failure occurs, however, the counterparty generally cannot determine whether the event is a default or a failed transaction. As a result, a technical failure may result in a loss of confidence in the counterparty that failed to settle, which could cause its counterparties to withhold settlement of other transactions, especially in fast moving markets. For the seller of a security, liquidity risk is the risk that payment will not be received from the buyer, possibly forcing the seller to borrow funds or to liquidate assets so that it can meet its own payment obligations on other transactions. For the buyer of securities, liquidity risk is the risk that the seller will not make delivery, possibly forcing the buyer to borrow the security to complete an obligation to deliver it to a third party. The costs associated with such liquidity pressures depend on the liquidity of the market in which the affected party must make its adjustment - the more liquid the market the less costly the adjustments.

Delivery versus payment

Principal risk can be eliminated by creating a link between securities transfer and funds transfer such that delivery of securities occurs if, and only if, payment occurs. This is the essence of Delivery versus Payment (DVP). If a securities market has such a DVP mechanism as part of its settlement arrangements, this will also reduce the likelihood of participants withholding deliveries of securities or funds when the market is under stress, thereby reducing liquidity risk.

Three approaches to linking securities delivery and payment, and achieving the elimination of principal risk, have been identified. These are illustrated in Diagram 10.

Diagram 10: THE DIFFERENT APPROACHES TO LINKING DELIVERY AND PAYMENT IN SECURITIES SETTLEMENT SYSTEMS

		Securities transfer	
		Trade-by-trade (gross)	**Net**
Funds transfer	**Gross**	**Model 1**	
	Net	**Model 2**	**Model 3**

- *Model 1 systems*. Both the securities transfer and the funds transfer are settled simultaneously on a gross basis through the processing cycle. This is the purest form of DVP, an example being the Fedwire Securities system for US government securities. A requirement for this model is funds transfer with real time gross settlement.

- *Model 2 systems*. These systems do not, strictly speaking, provide DVP since the transfer of the securities is settled on a gross basis through the processing cycle, before the net settlement of funds at the end of the processing cycle. However, such systems can be designed so that sellers of securities receive an authoritative assurance of payment, thereby very largely removing principal risk. An example of such a system is the Central Gilts Office (CGO) in the United Kingdom for settling UK government securities.

- *Model 3 systems*. Here, transfers of securities and funds are settled simultaneously on a net basis at the end of the processing cycle. If, and only if, all participants with net debit positions have sufficient balances of securities or funds to cover those positions, does final settlement take place. This is currently a widely used model internationally.

Risk management in securities settlement systems

Whilst mechanisms of the sort described above can remove the problem of principal risk, they do not address replacement cost risk and may only partially reduce liquidity risk. Indeed, in all three models it is likely that, either explicitly (through overdraft facilities) or implicitly (through the build-up of intraday net debit positions), credit will be extended to participants. Or, in other words, the securities settlement systems have to operate with sufficient intraday liquidity to prevent an unacceptable level of trade failures. So, when assessing the potential for systemic disruption within a securities settlement system, the key issue is not so much the robustness of its DVP mechanism, but rather the overall risk management and risk monitoring procedures, and the ability to deal with a situation in which a participant fails to meet its settlement obligations.

7 Cross-border payments and the international perspective

Differences between domestic and cross-border payment arrangements

In all but a totally closed economy, there is a need to make cross-border payments. There are some important contrasts between the mechanisms for making domestic and cross-border payments. For domestic payments, there are formalised payment systems, clearing houses etc, of the sort that have been described earlier. In contrast, for cross-border payments:

- there are few formalised systems; the payment arrangements are traditionally based upon bilateral correspondent banking relationships;

- the bank originating the payment has to arrange for settlement in the local currency of the bank receiving the payment;

- the payment may have to pass through a payment system of the local currency before it reaches the ultimate beneficiary.

Thus, looking at the example of a customer of a bank in the United States who needs to make a payment in sterling to a counterparty in the UK, the paying bank, having debited his customer the equivalent amount in US dollars, will send an instruction to its UK correspondent bank asking that bank to debit its nostro sterling account and send a sterling payment instruction to the receiving bank for the account of the UK counterparty.

If the paying bank's UK correspondent and the receiving customer's banks were one and the same, then the transaction would of course be relatively simpler - just an internal book-keeping entry. Or, as is nowadays increasingly common, the original paying bank may have an overseas branch or subsidiary which has access to the relevant local payment system, removing the need to have a separate correspondent in that location.

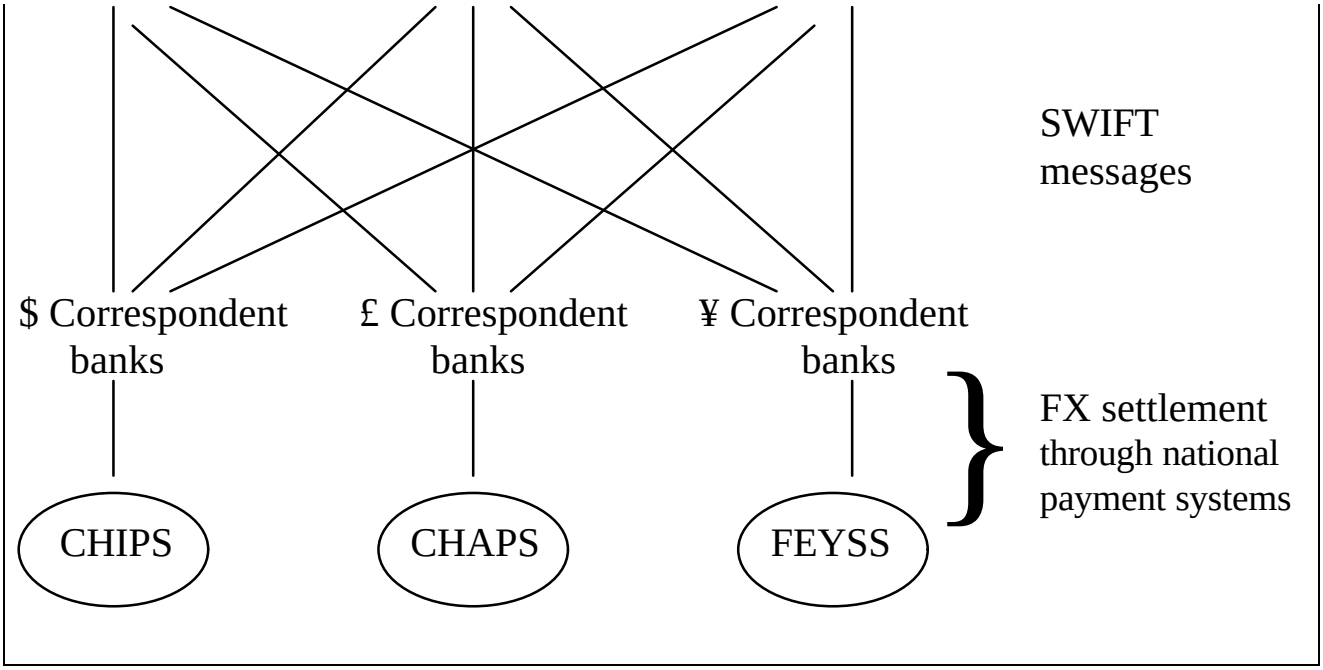
A further possibility for achieving the cross-border payment in this example would be through a link between the automated payment systems in the two countries concerned. Such linkages are increasingly used and can be a useful way of making regular or bulk cross-border payments (for example, paying pensions to employees who have retired to a different country).

The global payment system

There is therefore a growing interdependence of national payment systems, arising from the needs of international trade and finance, and increasingly evident in terms of foreign participation in domestic payment systems and in domestic financial markets generally. There is, in effect, a global payment system.

Diagram 11: THE INTERNATIONAL INTERDEPENDENCE OF PAYMENT SYSTEMS

New York London Tokyo FX markets



One of the best illustrations of these interdependencies is provided by the foreign exchange market. Unlike some financial markets, the foreign exchange market has no single location. Traders operate in different centres around the world, dealing with each other both within individual centres and between different centres. Settlement of a foreign exchange deal (two business days after the deal date in the case of a 'spot' deal) will involve two payments, one in each of the currencies being traded. Thus, using the example in Diagram 11, to settle a US dollar/Yen deal agreed by two banks in London requires that each of the banks send a message (usually via the SWIFT international telecommunications network) to their correspondent in the country where they have to deliver the yen or the dollars, instructing those correspondents to arrange delivery of the relevant currency. The influence of the world-wide foreign market on turnover in high-value payment systems is substantial: for the most heavily traded currencies, payments related to foreign exchange settlement can account for as much as 50% by value of the daily turnover. Large fluctuations in market activity will thus feed through (after a two-day lag in the case of spot trades) to the relevant payment systems, and are capable of putting pressure on the operational and liquidity management capabilities of those systems. By the same token, a serious disruption in a national payment system, which resulted in the failure of trades in overseas market centres to settle, could have a serious impact on confidence in those markets.

International standards for payment systems

There is thus a strong case for ensuring that each of the national payment systems that form a link in the global payment system operates according to a common, high standard of safety. In November 1990, a set of standards was published by the G10 group of central banks; these are listed opposite. The standards were produced in response to commercial bank initiatives to design and operate clearing houses for the multilateral netting of foreign exchange contracts. One such scheme is now in operation in London - the Exchange Clearing House Organisation (ECHO) - having met all six standards to the satisfaction of the central banks concerned.

Although the standards were originally targeted at 'cross-border and multi-currency netting and settlement schemes', they are in fact just as relevant to the operation of domestic payment systems and are a synthesis of many of the issues discussed in this *Handbook*. For example, in terms of the earlier discussion of settlement risk, it is the difficulty of properly meeting Standard IV that has provided much of the impetus for the move away from net settlement to real time gross settlement for high-value payment systems.

One of the main themes of the international co-operation and debate between central banks in the field of payment and securities settlement systems is the perceived need to bring all such systems - or at least those systems which have the potential for creating a systemic threat in the event of a system disturbance or failure - up to a common level of safety and robustness.

MINIMUM STANDARDS FOR THE DESIGN AND OPERATION OF CROSS-BORDER AND MULTI-CURRENCY NETTING AND SETTLEMENT SCHEMES

I Netting schemes should have a well-founded legal basis under 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 which 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 back-up facilities capable of completing daily processing requirements.

Cross-currency settlement risk

These efforts will contribute towards the control and eventual elimination of another major area of cross-border risk that relates directly to the example mentioned earlier of foreign exchange market settlement: cross-currency settlement risk, commonly know as 'Herstatt risk'. This is the risk that a counterparty to a foreign exchange deal may fulfil its obligation to deliver one currency but then not receive the currency due to be delivered by the its counterparty. This risk first attracted publicity in 1974 when a private German bank, Bankhaus Herstatt, failed after having received Deutschemark payments, related to foreign exchange transactions, through the German payment system, before having made the counterpart US dollar payments through the CHIPS payment system in New York. Such risk has periodically been a concern during instances of particular financial market stress or of bank failure. The main sources of this risk are:

(1) *inadequate risk management by individual banks*. Banks trading in the foreign exchange market can find that, because of the way their own back offices operate, they are irrevocably committed to paying out on one side of a deal 24 hours, or even 48 hours, before the settlement date, so they cannot stop the payment even if their counterparty goes into liquidation before his side of the deal is actually paid.

(2) *differences in time zones and payment system opening hours*. To use the example illustrated in Diagram 11, where two dealers in London agree a US dollar/yen trade, on the settlement date the yen payment will have been finally settled in Tokyo several hours before the US dollar payment system opens for business. The dealer who arranged delivery of yen is thus exposed to his counterparty for the full value of the deal (ie principal risk) until the dollars have been delivered.

(3) *settlement risk in domestic high-value payment systems*. Even if there is some overlap between the opening hours of the two national payment systems concerned, and even if the two payments are made at the same moment, one counterparty could still be facing principal

risk if his payment obligation is settled through an RTGS system, but the system in which he is due to receive payment is a net end-of-day settlement system that does not provide any intra-day assurance of settlement. As a result, an end-of-day settlement problem in that system could mean that he does not receive his funds.

The first source of risk can be addressed by reforming the arrangements and practices in each bank. It is possible to reduce the second source of risk by extending the operating hours of payment systems around the world so that there is a reasonable degree of overlap within which the particular pair of payments can be made. However, in terms of the third risk, it is also important to ensure that both of the relevant payment systems do provide intra-day finality - either via an RTGS mechanism or by having a net settlement system with risk control measures which, at a minimum, meet Standards III and IV of the six standards listed above.

In addition, correspondent banks can help reduce the risk by reacting quickly to their customers' requests to stop a payment instruction (because of fears about the financial position of their counterparty) before it is released into the payment system. Counterparties themselves can also help prevent the excessive build-up of this risk by having proper procedures for monitoring and controlling foreign exchange exposures; and by participating in arrangements for netting foreign exchange contracts, so as to reduce the amounts that ultimately have to be settled.

Elimination of cross-currency settlement risk requires genuinely simultaneous settlement of the two legs of a foreign exchange deal. Given the size of the world-wide market and the amounts that are potentially at risk, central banks and commercial banks are now working to develop such 'payment versus payment' mechanisms.

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