The development of a UK real-time gross settlement system

Efficient interbank payment systems are a vital part of the infrastructure of any modern economy. But where such systems are based on end-of-day settlement, there is scope for receiver risk. To eliminate that risk, a number of countries have now decided on settlement arrangements based on real-time gross settlement (RTGS); the initial decision to adopt RTGS in the United Kingdom was taken in 1992. This article explains the reasons behind that decision and describes the main features of the new system, which is due to be implemented before the end of 1995.[1]

Introduction

On an average day, payment systems in the United Kingdom process 16 million transactions with a total value of over £160 billion. One system, the Clearing House Automated Payment System (CHAPS), regularly processes daily payments totalling more than £100 billion through its 14 member banks.[2] The scale of these flows, and the size of the obligations they create between member banks, make it essential that these payment systems are based on sound settlement arrangements. It is also important, given the rapid growth in payments between banks, to eliminate the scope for instability at one bank to spread to others—and perhaps to be magnified—because of the inadequate design or structure of payment systems.

Awareness of these considerations has, over the last five years, led the Bank of England and the banking community to co-operate on a number of improvements to UK payment systems. The key element in this programme was initiated in 1992, when the Council for the Association for Payment Clearing Services (APACS) decided to adopt real-time gross settlement (RTGS) in the United Kingdom. A formal framework for introducing RTGS was established last year.

RTGS will mean that transactions across settlement accounts at the Bank of England will be settled continuously during the business day (in 'real time'), rather than only at the end of the day. In particular, it will mean that individual payments will be settled through CHAPS shortly after they are initiated. This will be achieved by linking a modified CHAPS network to a real-time accounting system at the Bank of England in which the settlement accounts of the banks will be held. The Bank will debit the sending bank for the value of each CHAPS instruction—provided it has the necessary funds on its account—and immediately credit the receiving bank with final central bank funds. This is a fundamental change from the present settlement process, where all interbank obligations arising during the day are netted and settled together at the end of the day.

In order to operate successfully with real-time gross settlement, the CHAPS member banks will require additional intra-day liquidity. To provide this, the Bank has agreed to grant the member banks intra-day liquidity facilities for RTGS purposes (see below).

The decision to change to real-time settlement was a response to growing concern over *receiver risk*—the possibility that the final settlement of payments between banks (relating to transactions already done) could be frustrated, at least in part, if one member of the system failed during the day and so was unable to meet its obligations at the end of the day.[3] RTGS is widely regarded as providing the best means of eliminating receiver risk from interbank payment systems; and a number of countries have developed, or are in the process of developing, systems based on RTGS at the central bank. The recognition that, by eliminating receiver risk, RTGS can reduce the scope for systemic risk in payment systems has also led EU central banks to support the wider use of real-time settlement for settling large-value payments.[4]

Payment networks in the United Kingdom

In the United Kingdom—as in many other countries—a number of payment systems operate in parallel; each of them offers some advantage in meeting the demands of a particular type of customer or transaction. A distinction is often drawn between those networks that handle large volumes of retail transfers with a relatively low average value, and those that deal with high-value or more time-critical payments, often referred to as wholesale systems.

In the United Kingdom, CHAPS is the most widely used system for making high-value, same-day sterling transfers. CHAPS was established in 1984 to offer a nationwide electronic network for making guaranteed and irrevocable sterling credits between its members, either on their own account or on behalf of customers.

(1) The article is intended to provide a general introduction to payment system risk as well as a description of recent developments on RTGS; it complements the remarks made by Mr Quinn in his speech to S.W.I.F.T.'s annual SIBOS conference in September 1993 and reprinted in the November 1993 *Quarterly Bulletin*, pages 530–34.
(2) The membership of the CHAPS system is due to expand to 16 shortly.
(3) The box on page 165 explains the concept of receiver risk and how the risk arises.
(4) Their recommendation is contained in the 'Report to the Committee of the Governors of the Central Banks of the Member States of the European Economic Community on Minimum Common Features for Domestic Payment Systems' by the Working Group on EC Payment Systems, November 1993.

A major reason for the introduction of CHAPS was the need to supplement the Town Clearing—a paper-based system providing same-day, high-value sterling debit clearing, but only in the area of the City of London. The efficient same-day service offered by CHAPS is now widely used to make payments for a variety of purposes, including the settlement of equity, foreign exchange and money-market transactions, company transfers and payments in relation to housing transactions. In contrast, the Town Clearing has become less important in recent years and tends to be used for a much more limited range of transactions. Indeed, now that RTGS development work has begun, the future of the Town Clearing is under review and it is likely that it will cease operations in due course.

In addition to these two wholesale systems, there are three retail sterling payment systems. The Cheque Clearing and the Credit Clearing deal with cheques and paper credit items respectively. The third system, BACS, is an automated clearing house offering electronic batch clearing for both debit and credit items, such as direct debits and standing orders.(1) All these clearings are settled across members' accounts at the Bank of England at the end of the day.

Payments also arise from the settlement of transactions in gilt-edged stock and sterling money-market instruments. These are generated in the Central Gilts Office (CGO) and Central Moneymarkets Office (CMO) Services(2) and settled across the banks' accounts with the Bank of England at the end of the day.

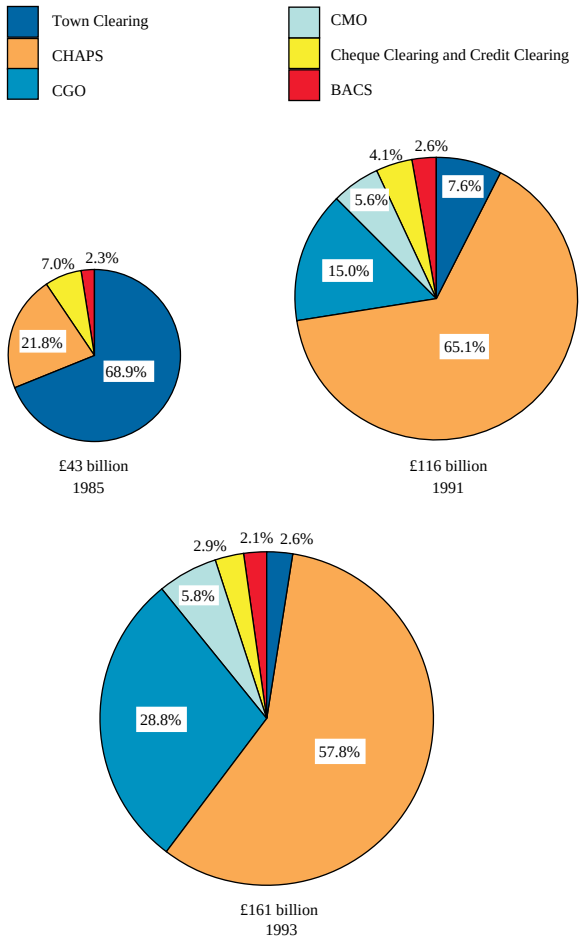
Chart 1 shows the systems' relative share by value in average daily payment flows. It shows that although the values settled through the Town and the retail clearings are large in absolute terms, they are much lower than those passing through CHAPS and CGO; in contrast, the retail clearings process much larger numbers of payments. During 1993, transfers equal to the value of UK annual GDP were settled through CHAPS roughly every seven days. Comparison of the three pie-charts in Chart 1 shows that the value of total payment traffic has grown by almost 300% since 1985 and that CHAPS has come to account for over half the total. It is for that reason that at this stage emphasis has been placed on eliminating receiver risk from CHAPS.

Current architecture of CHAPS

The CHAPS network currently operates on a distributed basis: there is no central computer system through which payment instructions between members are routed. Instead, during the day, each member bank sends payments directly to the others across a telecom network.

In order to participate, each member bank has a standardised piece of software—known as a gateway—which links its internal payment system to the CHAPS network as a whole. The gateway records the value of all incoming and outgoing payments. Settlement banks send payment instructions to one another without any data on individual transfers being sent to the Bank of England. At the end of the day, the gateways calculate final debit and credit balances for each member bank. These are sent to the Bank, which posts the multilateral net amounts to the members' settlement accounts.(3) It is only when the Bank has agreed the figures for the day and updated the banks' settlement accounts—usually by around 7.30 pm—that settlement (for CHAPS and all other sterling clearings) can be considered final. So receipt of an incoming CHAPS instruction does not mark final settlement, but is rather a promise by the sending bank to provide value at the end of the day.

Chart 1
Average daily values transferred through UK payment systems



Sources: APACS, Bank of England.

Receiver risk in CHAPS and risk reduction measures

Despite the fact that final settlement only occurs at the end of the day, since CHAPS was established banks and their customers have come to regard receipt of a CHAPS instruction during the day as akin to receipt of final central

(1) The structure and organisation of these retail systems and of CHAPS and the Town Clearing were outlined in the article 'Recent developments in UK payment clearing systems' printed in the August 1987 *Quarterly Bulletin*, pages 392–94.
(2) The key features of the CGO Service were outlined in the article 'Gilt-edged settlement: Phase 2 of the CGO Service' printed in the February 1987 *Quarterly Bulletin*, pages 80–82. A general introduction to the CMO Service was outlined in the article 'Central Moneymarkets Office', printed in the November 1990 *Quarterly Bulletin*, pages 514–18.
(3) These postings are made on a multilateral net basis for administrative convenience; the underlying legal position of each member is represented by the bilateral net amounts it owes to other members or its bilateral net claims on them.

Receiver risk and real-time gross settlement

To support the complex set of transactions that occurs in any modern economy, prompt, reliable and stable mechanisms for transferring funds between accounts at different credit institutions are essential. Central banks have a general interest in ensuring that these systems remain both secure and responsive to the economy's needs. They also have a responsibility to work with the banking community to limit the potential for systemic risk within payment networks. This is particularly important in the case of wholesale systems, given the large sums transferred each day.

One important type of risk in payment systems arises when a system member provides funds to its customers having received a payment instruction from another member but before final settlement. A receiving bank that offers irrevocable funds to its customer is exposed to the sending bank until settlement occurs; this exposure is commonly referred to as *receiver risk*. Those receiving funds prior to settlement may initiate further interbank transfers, which create additional obligations for their settlement banks. The chain of events may be repeated several times during the business day.

The ability of each bank to settle its obligations will, as a result, become increasingly dependent on the ability of all the other banks in the system to meet theirs. Were a settlement bank to fail before final settlement the other members would be deprived of a source of funds needed to fund their own payments. The existence of receiver risk is common in end-of-day net settlement systems such as CHAPS.

Real-time gross settlement provides a mechanism for eliminating receiver risk. There are a number of variants of RTGS systems, but all require that interbank transactions are recorded in the accounts of the central bank (or other settlement agent) as they happen. As a result, it is possible to structure the system so that a settlement bank only receives an incoming payment instruction once the payment has been settled by the central bank. This removes the possibility of settlement failure being transferred through the payment system as a result of one member becoming insolvent during the course of the day. Since, under such an arrangement, banks are unaware of the payments that have been made to them until they have been settled, there is also little scope for them to pass value to their customers before final settlement.

RTGS systems do not necessarily result in receiver risk being transferred to the central bank; if the central bank does not grant any additional intra-day liquidity, it will be responsible for transferring funds between accounts on an intra-day basis, but will not take on any exposures itself. Only where the central bank agrees to provide extra intra-day liquidity to the settlement banks will it acquire an exposure, and it may choose to limit this by taking some form of collateral or by entering into sale and repurchase agreements.

bank funds. Banks are often prepared to let customers make outward transfers on the basis of the receipt of an incoming CHAPS instruction, and each transfer is irrevocable and guaranteed by the sender's settlement bank. In providing funds to a customer against an incoming instruction, therefore, the receiving bank is relying on the credit standing of the sending bank rather than of the original payer. This increases the interdependence within the banking system.

In addition, the rules of CHAPS oblige a member bank that receives a CHAPS instruction to provide the customer with same-day funds. So the customer relies on its settlement bank to provide value, even if the sending bank is unable subsequently to do so. And, as a result, each CHAPS member bank incurs a direct exposure to another member whenever it receives a higher value of CHAPS instructions from that bank than it sends to it.(1) The unconditional requirement to provide value means that the settlement banks cannot eliminate receiver risk by making their obligation to pass funds on to their customers contingent on final settlement.

The values and volumes passing across CHAPS grew rapidly during the second half of the 1980s. It became clear to both market participants and the Bank of England that large and growing interbank exposures would be a feature of the system unless specific measures were adopted. Moreover, since the flows between banks were not spread evenly through the day, there was the potential for some member banks to develop large exposures to others at certain hours of the day. And some banks incurred substantial net debit positions in CHAPS which were balanced against anticipated inflows in the Town Clearing.

The then Governor sought to open a debate on these issues in his 1989 Ernest Sykes Memorial Lecture.(2) Following a period of detailed discussion and analysis involving the CHAPS banks, APACS and the Bank, it was decided in March 1991 that in the short term receiver risk should be controlled using a system of interbank limits, while further work was done on the best long-term method for removing such risk altogether. In 1992, the initial decision was taken to eliminate receiver risk by adopting RTGS as the basis for settlement.

At present, therefore, interbank exposures in CHAPS are controlled using net bilateral receiver limits (NBRLs). A

(1) These exposures are incurred by member banks directly, since they operate in CHAPS as principals, rather than as agents for their customers.
(2) The lecture was reprinted under the title 'Challenges facing the sterling wholesale payment systems,' in the August 1989 *Quarterly Bulletin*, pages 401–6.

NBRL allows a bank to limit the extent to which the value of its incoming CHAPS instructions from another member can exceed the value of its outward instructions to that bank. In this way, it can control the net inflow of funds from any single source for which it is obliged to give same-day value to its customers. Each bank decides the size of the NBRLs that it sets for its counterparties; it may change them at any time. NBRLs will continue to be used to control interbank exposures in CHAPS until RTGS is introduced.

To reinforce the discipline imposed by bilateral limits and to gain experience of the likely impact of RTGS, net sender limits (NSLs)—or net debit caps—have also been adopted. These restrict the extent to which the payments made by any one bank to all other members can exceed the value of all incoming transfers to it. To allow maximum flexibility, NSLs are currently self-assessed and can be raised during the day. NBRLs and NSLs have been introduced into CHAPS in stages during the last two years, and have provided valuable experience for member banks.

Although such limits have not previously been used in the United Kingdom to control receiver risk in the high-value clearings, similar techniques have been used in a number of other countries. In the United States, for example, banks operating within the Clearing House Interbank Payments System (CHIPS) are able to set bilateral credit limits on other participants and the clearing house applies a net debit cap on each participant. Net debit caps are also employed in the Zengin System, one of the wholesale payment systems that operate in Japan.

The RTGS programme

The introduction of RTGS in the United Kingdom is part of a broad international trend towards eliminating payment and settlement risk. There is real-time gross settlement within the Federal Reserve's Fedwire system in the United States, in the Bank of Italy's continuous Settlement System (BISS), in the SIC system in Switzerland and in the Netherlands Bank's current account (FA) system. The Bank of France is currently implementing a real-time gross settlement system, and the National Bank of Belgium proposes to implement one; other countries in the EU and elsewhere are planning to do the same.

While these systems share some features, there are also various differences—reflecting the institutional arrangements and business needs of the banking community in each country. The differences include: the range of transactions that are settled individually in real time; the ownership of the main wholesale payment network and message-routing arrangements; and the terms on which the central banks offer intra-day credit, if they do (the Swiss National Bank, for example, does not provide additional daylight funds in respect of the SIC system, and the Federal Reserve has opted for a system of charges for intra-day overdrafts that occur in Fedwire).(1)

The UK RTGS programme similarly reflects the United Kingdom's particular institutional arrangements. At its centre is the creation of a real-time link between the CHAPS network and the Bank's internal system for maintaining settlement accounts. Within the overall RTGS programme, therefore, there are two discrete but interrelated sets of tasks, one for the Bank and one for the CHAPS and Town Clearing Company Ltd. Given the interdependence of these and the need to co-operate on a number of interface issues, early in 1993 the Bank, the CHAPS and Town Clearing Company Ltd and APACS established a formal structure for programme co-ordination; this will remain in place throughout the programme. It is planned that implementation of the RTGS system will begin before the end of 1995; it will, however, be a phased process and details of the transition have yet to be finalised.

Main features of the RTGS system

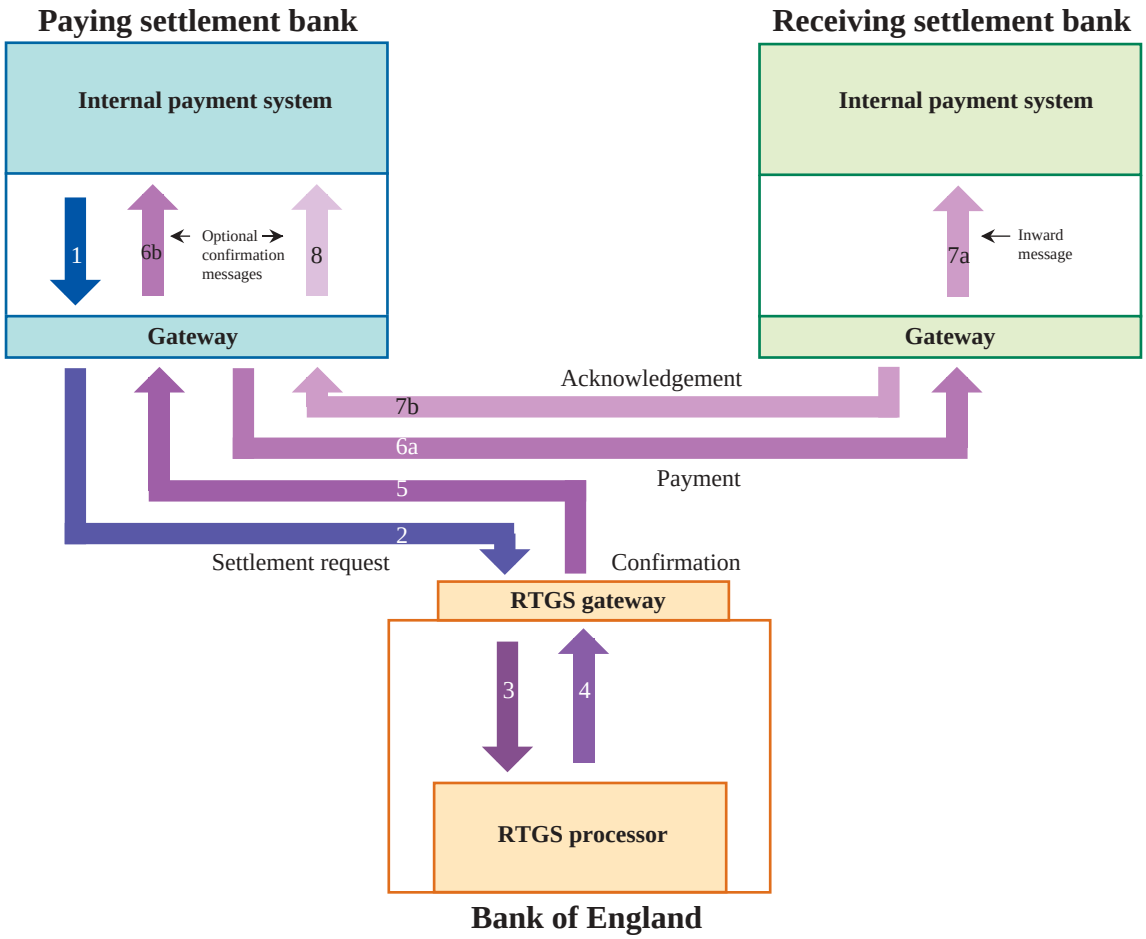
The RTGS system will provide the settlement banks with accounts at the Bank of England that can be updated continuously. Transactions that currently take place across settlement accounts at the Bank will use these accounts. So as well as CHAPS traffic, the other clearings will use these real-time accounts for settlement.

To allow real-time settlement of CHAPS payments, the present arrangements for routing messages across the CHAPS network will need to be modified. Under the new system, each CHAPS instruction will be settled at the Bank before it is sent to the receiving bank. The gateway software will be altered so that for each payment instruction sent by a bank a settlement request (a subset of the information in the main message) will first be sent to the Bank, while the main message is retained at the sending bank's gateway. Only if the sending bank has sufficient funds on its account will the Bank settle the transaction, by debiting the account and crediting the receiving bank; it will then return a confirmation to the sending bank. As soon as this is received, the main message containing the full payment details will be automatically released to the receiving bank; it will then know that it has received final and irrevocable funds on its account at the central bank. Chart 2 presents the message flows involved.

This form of message-routing can be described as L-shaped, to distinguish it, for instance, from the more usual V-shaped structure of the Fedwire system. With V-shaped routing, the full payment message (rather than a subset of the information) is passed initially to the central bank and then, once settlement is complete, on to the receiving bank. There are other variants, including a T-shaped structure, where one payment message is sent to the receiving bank while a duplicate is sent to the central bank. The L-shape has the merit that it builds on the existing architecture of CHAPS. It also ensures that a bank only receives an incoming payment message once it has been settled.

(1) Comparisons of the payment system arrangements in different countries can be found in the BIS publication 'Payment Systems in the Group of Ten Countries' (December 1993), and in 'Payment Systems in EC Member States', published by the Committee of EC Central Bank Governors (September 1992). Copies are available from Payment Systems Division (HO-6), Bank of England (071-601-5684).

Chart 2
Payments between CHAPS settlement banks under RTGS



Once RTGS is operational, a bank will normally send a settlement request to the Bank only when it has sufficient funds on its settlement account. To ensure that payments continue to flow smoothly and gridlock is avoided, the Bank will provide additional liquidity to the CHAPS banks on an intra-day basis. But sometimes at least, banks may have to delay releasing payment instructions, and hold them in a queue. The prime responsibility for managing any such queue will rest with the individual bank. This will not be a new development; and the experience of operating net sender limits has already provided a valuable opportunity to develop techniques for scheduling payment flows before RTGS is implemented.

Although payment flows will normally be managed within each bank, a 'circles' processing (or 'optimisation') facility will also be provided: to allow the simultaneous settlement of queued payments which, if they were all made, would largely balance; this will be a further measure to avoid gridlock. It is also planned that each bank will be able to communicate with the Bank using an enquiry link, to obtain information on its current balance and on entries made to its settlement account.

Liquidity arrangements

The balances currently held on settlement accounts at the Bank are small compared with the values passing across CHAPS each day. To ensure the smooth flow of payments through the system, the Bank has therefore agreed to provide the CHAPS banks with additional intra-day liquidity. A settlement bank will be able to obtain 'daylight' funds by selling assets to the Bank under same-day sale and repurchase agreements (repos). The Bank has indicated that it will be prepared to buy assets in the following categories for this purpose:

- HMG sterling Treasury bills;
- eligible sterling local authority bills;
- eligible sterling bank bills;
- sterling stock issued or guaranteed by HMG; and
- HMG foreign currency marketable debt.

In addition, banks will be allowed during the day to draw on their cash ratio deposits(1) at the Bank.

After the RTGS system has closed at the end of each day, cash ratio deposits will be reinstated and all outstanding

(1) Cash ratio deposits are non-interest-bearing deposits placed by the banks with the Bank of England to finance its activities; they are calculated as a proportion (currently 0.35%) of each bank's eligible liabilities. The amounts are adjusted twice a year but are not normally withdrawable.

repos will mature. Each bank will therefore have to ensure that it has sufficient funds on its settlement account to repurchase the assets previously sold to the Bank.

Banks will be able to enter into repos both at the start of and during the day. They will also be able during the day to buy back assets sold to the Bank earlier that day, as long as they have sufficient liquidity on their settlement accounts. Most of the relevant assets will be held in book-entry form in CGO, CMO or the European Settlements Office (ESO) operated by the Bank. These systems allow real-time movement of securities and so will provide the maximum flexibility for handling these transactions alongside a bank's normal trading of the assets concerned.

The move to real-time settlement—and in particular the Bank's provision of intra-day liquidity—is a major change, and one which could influence how the payment system operates and how banks manage their liquidity. It will therefore be introduced in a flexible and pragmatic manner so as to avoid major disruption.

Future developments

RTGS will provide the means of eliminating receiver risk in other financial market payment systems. In particular, it will allow full delivery-versus-payment (DVP) for securities settlement. This will be valuable for the settlement of high-value transfers of gilt-edged stock in CGO and money-market instruments in CMO, and also for equity settlement in the CREST system. The advantages of DVP are well-known.(1) Taking CGO as an example, at present transfers of stock take place against a promise to pay (an assured payment) issued by the buyer's settlement bank. Final settlement of these assured payments occurs only at the end of the day. Full DVP for gilt-edged stock would provide simultaneous transfer of assets in CGO and money—central bank funds—in RTGS. Given the values that pass across CGO each day, this would be a significant step towards eliminating receiver risk from London's markets.

In addition, a UK RTGS system will make it possible for final sterling payments to be synchronised with final payments in another currency in its own country's RTGS system. It will therefore provide the potential to remove foreign exchange settlement (or Herstatt) risk.

Conclusion

RTGS will offer a means of eliminating receiver risk from the high-value sterling payment systems. This will be a major advance on present arrangements, and will give the United Kingdom a settlement infrastructure in line with what are now regarded internationally as highest standards. As well as attacking payment system receiver risk, RTGS will make it possible to remove similar risks from both securities and foreign exchange settlement. Its introduction will therefore be a major advance in ensuring sound and secure payment systems for financial markets and the economy generally.

(1) The concept of DVP in securities settlement systems is explained in the BIS publication 'Delivery versus Payment in Securities Settlement Systems', (September 1992).