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# Settlement risk in foreign exchange markets and CLS Bank[1]

## Introduction

In September 2002, CLS Bank, a new financial institution set up to reduce the risk involved in settling foreign exchange transactions, began operation. This article describes how settlement risk arises, and how central banks and market participants have tried to reduce it. After reviewing the initiatives taken over the last two decades, the article discusses the background to the formation of CLS Bank and its likely effect on relevant risks.

## Herstatt

The collapse of Bankhaus Herstatt ...

On 26 June 1974, at 15:30 CET, the German authorities closed Bankhaus Herstatt, a medium-sized bank that was very active in foreign exchange markets.[2] On that day, some of Herstatt's counterparties had irrevocably paid large amounts of Deutsche marks to the bank but not yet received dollars in exchange, as the US financial markets had just opened for the day.[3] Herstatt's closure started a chain reaction that disrupted payment and settlement systems. Its New York correspondent bank suspended all US dollar payments from the German bank's account. Banks that had paid Deutsche marks to Herstatt earlier that day therefore became fully exposed to the value of those transactions. Other banks in New York refused to make payments on their own account or for their customers until they received confirmation that their countervalue had been received. These disruptions were propagated further through the multilateral net settlement system used in New York. Over the next three days, the amount of gross funds transferred by this system declined by an estimated 60%.

... and other disruptions to settlement systems

[1] The views expressed in this article are those of the author and do not necessarily reflect those of the BIS. Michela Scatigna and Stephan Arthur provided excellent research assistance.

[2] For a discussion of Herstatt Bank's role in foreign exchange markets, see Remolona et al (1990).

[3] The value of transactions to be settled for Bankhaus Herstatt was estimated at $200 million. Some banks had also entered into forward trades with Herstatt. These trades were not yet due to be settled when the bank was closed and had to be replaced.

Bankhaus Herstatt's closure was the first and most dramatic case of a bank failure where incomplete settlement of foreign exchange transactions caused severe problems in payment and settlement systems. Several other episodes occurred in the 1990s but they were less disruptive.[4] In February 1990, problems were created by the failure of Drexel Burnham Lambert Group, whose London subsidiary, Drexel Burnham Lambert Trading, was active in foreign exchange and gold markets. In July 1991, the liquidation of BCCI caused losses to its UK and Japanese foreign exchange counterparties. At the time of the attempted coup in the Soviet Union in August 1991, settlement systems were affected by uncertainty about some financial institutions that were either operating in the Soviet Union or owned by institutions based there. The collapse of Baring Brothers in February 1995 caused problems in the ECU clearing arrangements.

## Settlement risk

The origin of the problem

The collapse of Herstatt highlighted the fact that major disruptions can arise out of the risk exposures involved in the traditional method of settling foreign exchange. These exposures come about because settlement typically takes place in the countries of issue of each currency, so that the separate legs of a foreign exchange transaction are settled independently and in many cases at significantly different times.

A market survey conducted by central banks in 1995 found that there was commonly a lag of at least one or two business days between the time when a party to a foreign exchange transaction can no longer cancel unilaterally a payment instruction for the currency it sells and the time when the currency purchased has been received with finality (CPSS (1996)). In addition, the survey found that it could take a further one or two business days for a bank to establish with certainty whether it had received payment. Hence, more than three days – plus any intervening holidays and weekends – could elapse before the bank knew with certainty that it had received the currency it had bought.

One key problem was that the major payment systems used to transfer large-value funds between banks did not operate to a daily timetable that permitted simultaneous or near simultaneous settlement of the currencies. There was limited overlap in the operating hours between time zones.[5] Moreover, many of these payment systems were designed in such a way that final settlement of each day's payments took place at a single point in time, namely the end of the system's operating day.

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[4] CPSS (1996) provides a detailed account of these episodes.

[5] For example, delivery of dollars to a bank in Japan by a US bank in New York would occur during New York business hours, while the corresponding delivery of yen by the Japanese bank to its US counterparty would occur during Tokyo business hours. The bank delivering yen could have to wait up to 12 hours before receiving dollars (see Graph 1).

Foreign exchange settlement risk ...

The risk that one party in a foreign exchange trade pays out the currency it sold but does not receive the currency it bought is called foreign exchange settlement risk or "Herstatt" risk. The exposure to a single counterparty, even if short-lived, can be very large relative to the capital of the participants in a transaction. In fact, it can be a multiple of a bank's capital in certain conditions (CPSS (1996)).

... has two main aspects

Settlement risk has two main aspects: credit risk and liquidity risk. The reason why credit and liquidity problems arise is that in foreign exchange markets, the full notional value of each currency is exchanged. Credit risk arises because after a bank commits irrevocably to pay its currency, its counterparty may fail to meet its obligation for full value when due or at any time thereafter. In the extreme case of counterparty failure, such as that of Bankhaus Herstatt, the bank which paid does not receive the full countervalue, but rather ends up with an unsecured claim in the insolvency procedure. The ultimate countervalue recovered after a potentially long delay could be significantly less than the amount originally paid in the selling currency. Liquidity risk exists since a counterparty may not be able to settle for full value at the due date but could do so at some unspecified time thereafter. Liquidity exposure increases with the size of the transaction, and the potential seriousness of the risk increases if the markets that have to be accessed at short notice to obtain alternative sources of funds are unavailable or lack depth

## Payment and settlement activity

Daily averages

| | Number of transactions[1] | | Value of transactions[2] | | Value of transactions[3] |
|---|---|---|---|---|---|
| | 1999 | 2000 | 1999 | 2000 | 2000 |
| Canada | | | | | |
| LVTS | 12 | 14 | 61 | 69 | 6.35 |
| Japan | | | | | |
| FXYCS | 40 | 37 | 248 | 230 | 5.05 |
| BOJ-NET | 19 | 19 | 1,202 | 1,303 | 28.59 |
| Switzerland | | | | | |
| SIC | 562 | 593 | 109 | 105 | 43.69 |
| United Kingdom | | | | | |
| CHAPS Sterling | 79 | 86 | 287 | 295 | 31.04 |
| CHAPS Euro | 10 | 13 | 142 | 152 | 15.99 |
| United States | | | | | |
| Fedwire | 408 | 430 | 1,363 | 1,507 | 15.14 |
| CHIPS | 227 | 237 | 1,182 | 1,159 | 11.64 |
| European Union | | | | | |
| EURO1 | 70 | 98 | 175 | 197 | 3.35 |
| TARGET | 168 | 190 | 950 | 1,045 | 17.78 |

[1] In thousands. [2] In billions of US dollars. [3] As a percentage of GDP.

Source: CPSS (2002). Table 1

at the time of day they may be called on. One important source of liquidity risk is operational risk. The payment process is subject to this type of risk to the extent that a payment may be misdirected or may not be carried out on time owing to a technical failure or human error.

Systemic implications

The dynamics of the collapse of Herstatt showed that settlement risk can have systemic implications when the failure of a bank to meet its payment obligations affects the ability of other market participants to fulfil theirs. Not least because of the magnitude of foreign exchange settlement flows, payment systems can be an important channel for the propagation of systemic strains. To give an idea of the relative size of overall exposures, the daily flows through UK payment and settlement systems are equivalent to 47% of annual UK GDP (Table 1).

Foreign exchange markets particularly vulnerable

Settlement risk in foreign exchange markets is likely to have systemic implications for several reasons. First, foreign exchange activity has an international dimension, since currencies are cleared in their home country. Since the working hours of payment systems in the biggest foreign exchange centres – London, New York and Tokyo – do not overlap completely, a large proportion of foreign exchange activity is settled outside the business hours of one of the counterparties. Second, trading in foreign exchange markets has grown very rapidly and is very large compared to activity in other financial markets. In April 2001, average daily trading in the euro/dollar pair, the biggest foreign exchange market segment, was $354 billion, well above the $298 billion turnover in the largest bond market (US Treasuries) and the $42.3 billion traded on average each day on the world's most active stock market (the New York Stock Exchange).[6] Third, trading between banks accounts for the largest share of foreign exchange market activity. According to the 2001 Central Bank Survey of Foreign Exchange and Derivatives Market Activity, inter-dealer trading captured about 60% of total turnover (Table 2). Finally, activity in foreign exchange markets is increasingly concentrated in the hands of relatively few banks.

## Reported foreign exchange market turnover by counterparty[1]

Daily averages in April, in billions of US dollars

| | 1992 | 1995 | 1998 | 2001 |
|---|---|---|---|---|
| Total | 776 | 1,137 | 1,429 | 1,173 |
| With reporting dealers | 540 | 729 | 908 | 689 |
| With other financial institutions | 97 | 230 | 279 | 329 |
| With non-financial customers | 137 | 178 | 242 | 156 |
| Local | 317 | 526 | 657 | 499 |
| Cross-border | 392 | 611 | 772 | 674 |

[1] Adjusted for local and cross-border double-counting. Excludes estimated gaps in reporting.

Source: BIS (2002). Table 2

[6] Sources: BIS (2002); Federal Reserve Bank of New York (cited by the Bond Market Association); NYSE.

## Initiatives to reduce settlement risk

In 1996, the G10 central banks set out a three-track strategy to reduce the systemic risk associated with foreign exchange settlement. The strategy comprised action by individual banks to control their foreign exchange settlement exposures, action by industry groups to provide risk-reducing multicurrency services and action by central banks to induce rapid private sector progress (CPSS (1996)).[7]

Reduction in the delay between two legs of a transaction ...

Subsequently, two complementary approaches were followed to reduce settlement risk.[8] The first approach aimed to shorten the duration of settlement exposures. One way in which this was achieved was through improved measurement and management of exposures by individual banks. In addition, improvements in high-value payment systems increased the potential for a closer alignment of settlement timings. Intraday final settlement was introduced more widely, through the adoption of real-time gross settlement (RTGS) systems. RTGS systems process and settle payments on an item by item basis in real time during the system's operating hours. These operating hours were extended in the 1990s, increasing the overlap between time zones (Graph 1).

... and in the number and size of payments requiring settlement

The second approach focused on reducing the settlement flows between counterparties associated with the original trades. This was achieved mainly by private sector initiatives to develop bilateral and multilateral arrangements for the netting of foreign exchange transactions accompanied by legislative changes to recognise netting arrangements. In bilateral netting arrangements, such as FXNET, trades are netted by counterparty pair each day, resulting in one payment per currency for each of the two counterparties. A multilateral netting arrangement, ECHO, also operated for a few years in the 1990s. Amounts owed among ECHO members were netted each day through a clearing house, resulting in one payment per member per currency to or from the clearing house. Multilateral netting reduced the settlement flows to which it was applied by an estimated 70%, compared with 50% for bilateral netting (CPSS (1998)).

But settlement risk remained important

While these various measures reduced either the size or the duration of settlement exposures and certainly reduced liquidity pressures, they did not achieve simultaneous finality of received payments. Hence, all these initiatives contributed to a decrease in settlement risk but did not eliminate it.

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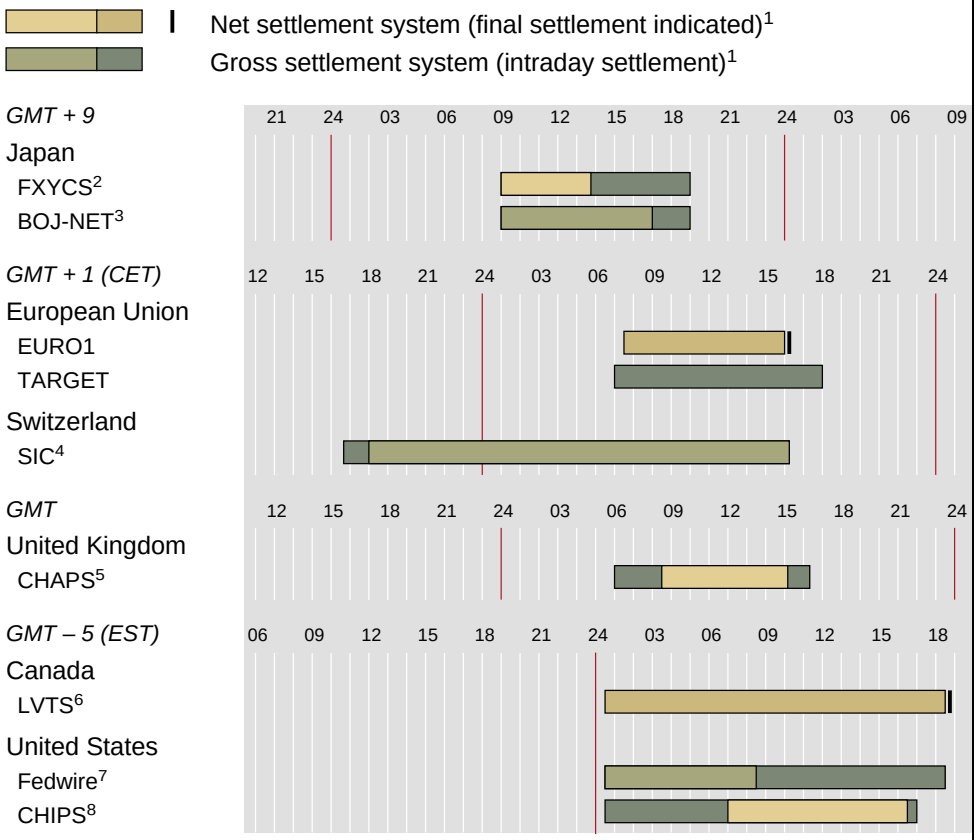
[7] See CPSS (1993, 1996, 1998) for a detailed analysis of the issues involved in settlement risk.

[8] Neither of these approaches aimed at changing the market convention for spot deals that settlement would take place two days after the agreement to trade, which does not affect settlement risk.

## Operating hours of selected large-value interbank transfer systems

For same value day




[1] The lighter shading represents operating hours in 1993, while the full extent of both shaded areas represents operating hours in November 2002. A net settlement system was in operation in 1993 for FXYCS, CHAPS and CHIPS, but they have since moved to a gross settlement system (FXYCS to a system with both DNS mode and RTGS mode, see footnote 2 below, CHIPS to a hybrid system, see footnote 8 below). [2] Although in 1998 FXYCS introduced RTGS mode operation from 09:00 to 17:00, almost all payments are still processed in DNS mode. Since May 2002, the closing time for RTGS mode operation has been extended from 17:00 to 19:00 for participants who have applied for access to the system until that time; this can be extended to 20:00 if necessary. [3] Since May 2002, the closing time of the system has been extended from 17:00 to 19:00 for participants who have applied for access to the system until that time; this can be extended to 20:00 if necessary. [4] Operating hours were extended in 2002. [5] Operating hours were extended at the beginning of 1999. [6] The initialisation period, for collateral pledging/valuation, setting of bilateral limits, etc, begins at 00:30; payment message exchange begins at 01:00. [7] Operating hours were extended in 1997. [8] A substantial proportion of the day's payments (by value) is effectively offset by bilateral or, in some cases, multilateral netting of payments prior to settlement. However, the majority of payments (by number) are settled on a gross basis. Settlement is final intraday.

Source: National data. Graph 1

## CLS Bank

The payment-versus-payment approach

In the mid-1990s, efforts to tackle the problem of settlement risk led a group of major foreign exchange market participants, known as the G20 banks, to work on a solution based on the payment-versus-payment principle. According to this principle, the two legs of a transaction are settled simultaneously, and in such a way that the one cannot occur without the other. In 1997, the G20 banks set up a limited purpose financial institution, CLS Bank International, to develop their chosen solution.

CLS Bank went live in September 2002

In September 2002, CLS Bank went into operation, settling transactions involving seven currencies: the US dollar, euro, yen, pound sterling, Swiss franc, Canadian dollar and Australian dollar.[9] In mid-November 2002, CLS had 67 shareholders, mainly large international banks. In the first two months of its operations, the volume of transactions settled through CLS Bank increased rapidly (Graph 2).

Different types of membership

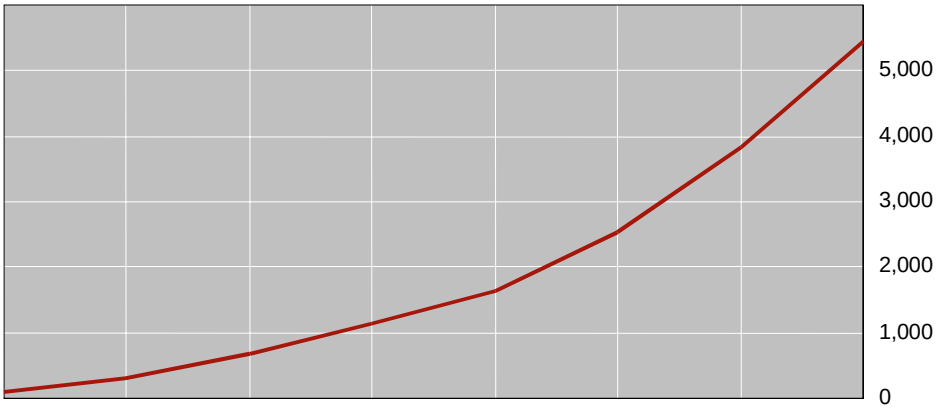
Market participants can make use of the CLS system in different ways, depending on whether they are settlement members or third parties. Settlement members hold multicurrency settlement accounts at CLS Bank and can submit directly to CLS Bank the details of transactions, either on their own behalf or for their customers. They are responsible for providing the funding for the amounts to be settled. Settlement members must be CLS shareholders. Settlement members may also offer third-party services whereby they act as principal but submit details of transactions to be settled on behalf of their respective customers. CLS Bank itself is not involved in any relationship with third parties, which means that if a third party fails to meet its obligation vis-à-vis a settlement member, CLS Bank is not directly affected.

Settlement in different phases

Settlement through the CLS system takes place in phases.[10] At the beginning of the process, members submit details of transactions to be settled, normally by 00:00 CET on the settlement day. Based on all the instructions, CLS Bank then calculates each settlement member's net total pay-in/payout position for each currency and at 06:30 CET issues a pay-in schedule for each member. Payments to CLS Bank are executed between 07:00 and 12:00 CET,

Cumulative gross value of payment instructions settled in CLS bank

In billions of US dollars




Source: CLS Group. Graph 2

[9] The Swedish krona, Norwegian krone and Danish krone, and the Hong Kong, New Zealand and Singapore dollars are expected to be the next currencies to be added to the system.

[10] In this article, the description of the CLS mechanism is confined to settlement members. For a detailed description of settlement under the CLS system, see also Bronner (2002).

subject to strict hourly deadlines. At least part of this time is within the operating hours of six of the seven RTGS systems used to make payments to and from CLS Bank. In Australia, CLS payments are made during a special evening session of the payment system. Each settlement member holds a single multicurrency account, with sub-accounts for each of the seven currencies. CLS Bank settles each trade over these accounts by simultaneously crediting the buyer's account in the currency that is bought and debiting the seller's account in the currency that is sold. Payments between settlement members and CLS Bank are made through the local payment system using the account that, for each currency, CLS Bank holds at the respective central bank.

In the CLS system, there is a clear distinction between the settlement of transactions and funding, ie the transfer of currency between settlement members and CLS Bank. Trades are settled between members on a *gross* basis on CLS Bank's books. By contrast, member banks have to fund only their *net* positions on CLS Bank's central bank accounts.

The impact of CLS on foreign exchange markets

The CLS system is likely to have a significant impact on banks that are active in foreign exchange markets. Its design, and in particular the funding arrangements, imply high potential efficiency gains. According to simulation exercises conducted by CLS Bank, in normal times about 90% of all foreign exchange market transactions could be settled in less than one hour. These advantages of CLS will come at the cost of increased demands on banks' liquidity management because of the tightness of the schedule of timed payments and the fact that a large number of transactions will be settled outside normal business hours, particularly in some currencies.

*Does CLS eliminate settlement risk?*

A key issue is the effect of CLS on the risks involved in foreign exchange settlement. To understand this effect, it is useful to look at its possible impact on the two components of settlement risk, ie credit risk and liquidity risk.

Credit risk is eliminated ...

CLS eliminates credit risk in all but very extreme circumstances. Settlement members generally do not lose principal if their counterparty fails. The mechanism that the CLS system uses to achieve this is based on the payment-versus-payment principle and the positive account balance rule. The positive account balance rule requires settlement members to hold a non-negative overall balance (ie taking all currencies together) on their CLS Bank accounts at all times.[11] The idea is that if a settlement member defaults, CLS Bank will not be owed money by this member and will have sufficient funds to pay the other settlement members.

CLS Bank uses two mechanisms to prevent overall balances from turning negative because of adverse exchange rate movements during the settlement process. First, it applies "haircuts" to the exchange rates used to compute each

[11] This is equivalent to saying that settlement members cannot have intraday overdrafts overall. At the end of each day, they will always hold a zero balance on their CLS Bank accounts.

member's overall balance.[12] Haircuts reduce the positive value of settlement members' long positions and increase the negative value of their short positions. Second, limits are imposed on the extent of any negative balance in individual currencies. These limits are specific to each currency.[13]

... except in some very extreme circumstances

However, some residual credit risk remains in the CLS system, to the extent that there is a possibility of CLS Bank having a credit exposure to a member that fails and of surviving members becoming liable under a loss-sharing agreement. This could only occur in exceptional circumstances, where there is a pay-in failure by a member, the size of whose negative balance in one or more currencies combines with an intraday movement in the relevant exchange rate(s) so great that the haircuts are not enough to prevent the overall balance of the failing bank from turning negative. In this extreme case, the amount that CLS Bank owes its settlement members may exceed the aggregate amount of currencies that CLS Bank holds. To protect itself against these extreme circumstances, CLS Bank has in place provisions for loss-sharing among surviving members.[14] The idea is that CLS Bank should find the necessary resources itself rather than having to turn to external support.

Facilities in place to reduce liquidity risk ...

The effect on liquidity risk is more complex. In the first place, in respect of transactions already settled over the books of CLS Bank, particular arrangements are in place to enable the company to complete its payouts in the event that a member fails to pay in. The positive account balance rule ensures that there is value on that member's account. However, the rule applies to all currencies taken together, rather than to each currency. Hence, CLS Bank is not automatically able to pay out to other members in the currencies due. To enable it to complete its payouts in the relevant currencies, CLS Bank has in place liquidity facilities with major private sector market players, under which it can swap one currency for another in these circumstances.

... but not sufficient to eliminate it

However, while the CLS system reduces liquidity risk significantly, the liquidity facilities in place are not sufficient to eliminate liquidity risk on settled transactions for several reasons. First, these facilities are finite. Their amounts are related to the limits on negative balances in individual currencies in such a way that this mechanism can cope at least with the default of one member and one liquidity provider. However, they are not necessarily sufficient to cope with multiple defaults that occur on the same day. In such extreme circumstances, CLS Bank might have to make payouts to some members in the wrong currencies. This problem could potentially be exacerbated by the fact that key players in foreign exchange markets are likely to be at the same time

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[12] A haircut is the difference between the market value of a security and its collateral value (CPSS (2001)).

[13] These are called short position limits. CLS Bank also imposes aggregate short position limits on settlement members, which represent the maximum total of short positions that they may incur. These aggregate limits are specific to the settlement member.

[14] Settlement members will also retain some credit exposure to their third parties. This issue is not treated in this article (see footnote 11).

settlement members *and* liquidity providers in some currencies. To address this problem, CLS has the resources to deal with the failure of the largest settlement member obligor to CLS, even if that failing settlement member is also the largest liquidity provider in each currency.

CLS does not guarantee that it will be able to settle all transactions submitted to it, if a settlement member fails to pay in accordance with its schedule. Under such circumstances, some transactions may remain unsettled that day and the calculation of pay-in and payout amounts for other members will be revised accordingly. This possibility of short-notice alterations to pay-in schedules calls for a high degree of sophistication on the part of settlement members in their liquidity management.

To facilitate liquidity management by reducing expected pay-in amounts, settlement members can make use of a tool called the in/out swap. Using this tool, a settlement member with a large pay-in to make to CLS Bank in one currency and a large payout due in another currency is matched with another settlement member in the opposite position. In/out swaps facilitate the task of liquidity management, but they reintroduce an element of risk, in that the "out" legs of the swaps are settled using traditional means of settlement and are subject to traditional settlement risks.

Implications for operational risk

While the CLS system virtually eliminates credit risk and greatly reduces liquidity risk, it imposes highly sophisticated technical requirements on the system, as well as on settlement members. This is particularly true given the tight time schedule for pay-ins. Operational problems at one member bank or in one national payment system could have important repercussions. Hence, the introduction of CLS changes the nature of the potential sources, as well as the channels for the potential impact, of operational problems. Moreover, it is unclear what impact large time-sensitive payment requirements will have on each currency's national RTGS system and hence on the banking system as a whole.

## Conclusions

The payment system disruptions created by the collapse of Bankhaus Herstatt in 1974 and the growth of foreign exchange markets have highlighted the systemic implications of settlement risk. In the last two decades, steps have been taken to improve the banking system's ability to contain settlement risk, mainly by reducing the delay between the two legs of a transaction and by devising mechanisms to reduce the settlement flows between counterparties. Significant progress has been achieved more recently by the implementation of CLS, a service set up by private sector market participants to settle both legs of foreign exchange transactions simultaneously for its members over its own books.

CLS could potentially have a major impact on foreign exchange settlement. It is designed to reduce credit and liquidity risk significantly and increase the efficiency of settlement operations. However, part of this risk may not be eliminated from the banking system as a whole. In particular, because of the tightness of its time schedule, the time sensitivity of payments and the fact

that it relies on RTGS systems in different time zones around the world, the CLS system may put a premium on managing operational risk efficiently and make liquidity management an increasingly demanding task for major banks, as well as the banking system as a whole.

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