

## Reducing foreign exchange settlement risk<sup>1</sup>

*Much progress has been made in reducing settlement risk in foreign exchange markets, particularly through use of CLS Bank. However, the remaining exposures are sometimes still significantly large and not always well managed, creating the potential for systemic risk. To address this problem, it is particularly important that prudential regulators promote effective management of the risk by market participants.*

*JEL classification: G15, G18, G2, G21, G28, G32.*

Foreign exchange settlement risk has proved to be a persistent and problematic issue in financial markets. Despite much discussion and even a significant amount of action, the size and nature of the risk mean that it could still disrupt the stability of global financial markets.

This special feature examines the results of a survey that took place in April 2006 to assess the degree of risk. The survey was carried out for the Committee on Payment and Settlement Systems (CPSS) by 27 central banks and involved 109 institutions (both banks and non-banks) that were selected to cover 80% of the foreign exchange (FX) market in 15 currency areas (CPSS (2008)). This feature first sets out the background to the survey, and then summarises the survey's key findings. Next it explains why there is still a problem with FX settlement risk, and finally it suggests that there are two key actions which need to be taken if the problem is to be addressed effectively.

### The nature of FX settlement risk

Trading in financial markets typically requires settlement – delivery of the asset by the seller and payment for it by the buyer. The market for foreign exchange is no different, except that settlement involves two payments – ie the exchange of one currency for another. Although FX settlement is often regarded as a routine activity that is less interesting than the trading itself, it deserves close attention because of the risk that can be involved, namely the risk that one party to an FX trade pays the currency it has sold but fails to receive the currency it has bought. The risk arises because, using the traditional method of

---

<sup>1</sup> The author thanks Jimmy Shek and Marcus Jellinghaus for their technical assistance. The views expressed in this feature are those of the author and do not necessarily reflect those of the BIS, the CPSS or the central banks involved in the survey.

settling trades, there is no mechanism to ensure that you pay only if you are paid (a mechanism called payment versus payment or PVP). Both counterparties to the trade therefore commit themselves to paying away the currency they are selling before they are certain that they will receive the currency they are buying. Moreover, the traditional settlement process can be a relatively slow one, meaning that the counterparties can be exposed to this risk for a significant period, often more than a day (see Box 1 for more on how the risk arises).

FX settlement risk (sometimes also known as Herstatt risk<sup>2</sup>) is therefore primarily a counterparty risk. It is equivalent to the risk of making an unsecured loan to the counterparty: you have paid money to the counterparty with no guarantee that you will be paid back. As such it involves both principal risk (you may not get paid at all, so you may lose the full value of the trade) and liquidity risk (in this context, the risk that, even if the counterparty does pay you, the payment comes at the wrong time and/or in the wrong currency, leaving you without the currency you need when you need it).<sup>3</sup> Given the size of the FX market – estimated to involve daily turnover equivalent to \$3.2 trillion in April 2007 – the potential risk is significant.<sup>4</sup>

FX settlement risk is a significant counterparty risk

Because of this, in 1996 the G10 central banks launched a comprehensive strategy to contain FX settlement risk. At the time, the duration and size of FX settlement exposures tended to be underestimated by banks, while their risk management measures were often inadequate. Indeed, the scale of exposures arising from settling FX trades was such that the failure of a single participant in the FX market could have caused systemic risk to materialise – ie it could have caused the failure of other participants (CPSS (1996)). The strategy to address the problem involved three tracks: action by individual banks to control their FX settlement exposures; action by industry groups to provide risk-reducing services for settling FX trades; and action by central banks to induce private sector progress on the previous two tracks.<sup>5</sup>

Central banks have a strategy to reduce it

---

<sup>2</sup> The collapse of Bankhaus Herstatt was one of the earliest cases where FX settlement risk crystallised. The bank, a medium-sized bank that was active in the FX markets, was closed by the German authorities on 26 June 1974. Some of its FX counterparties had already paid Deutsche marks to the bank but had not yet received the US dollars that they were buying in exchange. For more about this and other cases where settlement problems have arisen, see CPSS (1996) and Galati (2002).

<sup>3</sup> Thus although the main concern is with outright default by the counterparty (eg because of insolvency), even technical fails that are corrected on a subsequent day (eg when there are temporary operational difficulties) have the potential to cause liquidity problems.

<sup>4</sup> For estimates of the size of the FX market, see BIS (2007).

<sup>5</sup> For more information about the 1996 strategy, see CPSS (1996).

## Box 1: How FX settlement risk arises

An example of how settlement risk arises when using traditional correspondent banking

In this example, Bank A has a spot trade with Bank B in which it is selling yen for US dollars. The trade is executed on Day  $V-2$  for settlement on Day  $V$  (value day).

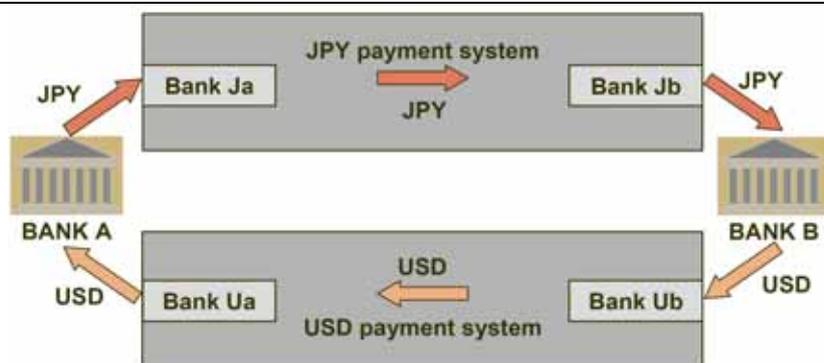
After the trade has been struck, Bank A sends an instruction to its correspondent in Japan (Bank Ja), asking the latter to send the yen to Bank B's correspondent there (Bank Jb) on Day  $V$ . Bank Ja executes this instruction sometime during Day  $V$  by debiting the account that Bank A holds with it and sending the yen to Bank Jb via the relevant payment system. After Bank Jb has received the funds, it credits them to Bank B's account and informs Bank B that they have arrived.

In parallel, Bank B settles its side of the trade by a similar process in which it instructs its correspondent in the United States (Bank Ub) to send US dollars to Bank A's correspondent there.

Settlement risk arises because each counterparty may pay the currency it is selling but not receive the currency it is buying. The underlying cause is the lack of any "link" between the two payment processes (in yen and dollars) to ensure that one payment takes place only if the other also does.

- Looking at the trade from Bank A's point of view, its exposure to settlement risk starts when it can no longer be certain that it can cancel its instruction to pay Bank B. This depends primarily on any agreement between Banks A and Ja about cancellation. In the absence of a specific agreement, Bank A cannot be certain whether it can cancel or not and so its exposure begins immediately it has sent the payment instruction to Bank Ja, which is likely to be on Day  $V-1$  or even  $V-2$ . Even if there is a specific agreement, Bank Ja may need some time to process a cancellation request by Bank A, so the exposure may start at least several hours before the yen payment system opens on Day  $V$ . The effective cancellation deadline may therefore be very early on  $V$  or even on  $V-1$  in Japanese local time, which, if Bank A is located in (say) Europe, will be even earlier in Bank A's local time because of time zone differences.
- Bank A's exposure ends when Bank Ua credits its account with the dollars received from Bank Ub. Bank Ua may not receive the funds until just before the close of the relevant payment system, and it may be some time after that that the funds are credited to Bank A's account. This could be relatively late on Day  $V$  in US local time, and even later on Day  $V$  or even on Day  $V+1$  in the local time of Bank A. Bank A's actual exposure to this trade could therefore last more than 24 hours.

Bank B also faces settlement risk. Its exposure period will differ from that of Bank A to the extent that Banks B, Ub and Jb have different arrangements compared to those of Banks A, Ja and Ua, and the relevant US and Japanese payment systems have different opening hours. Time zone differences are also important. In this trade, time zones work against Bank A because it is selling a currency that settles in an early time zone (so it is committed to selling its currency relatively early) and buying one that settles in a late time zone (so it will receive the currency it is buying relatively late), which extends the duration of its exposure. Conversely, the time zone difference works in Bank B's favour. However, it is important to note that the problem does not arise solely because of time zone differences.



## Settlement methods

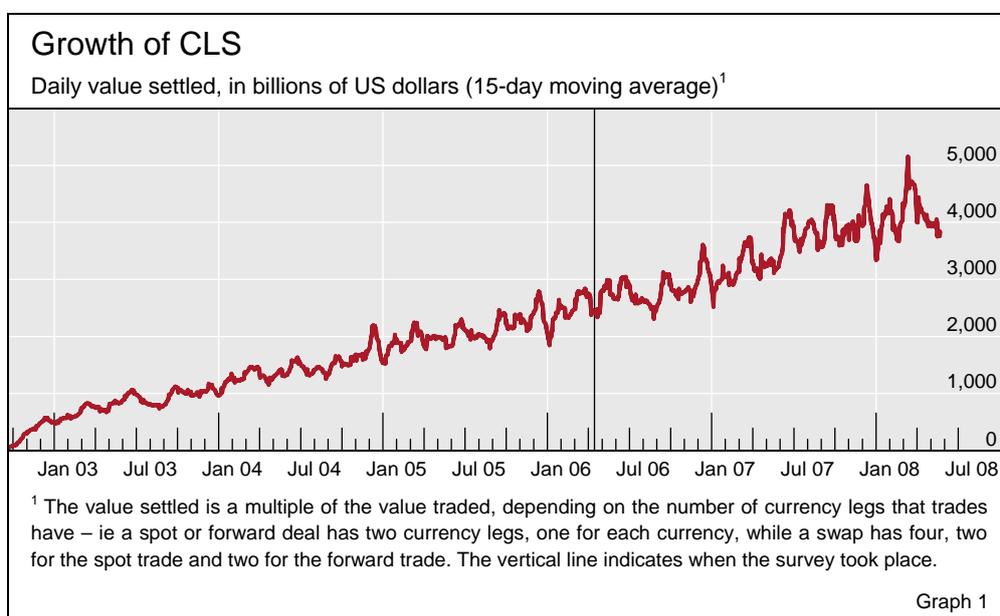
The 2006 survey found that much progress has been made since 1996, particularly on the provision of risk-reducing services by industry groups, the second track of the strategy. Most significant was CLS Bank (CLS),<sup>6</sup> which started operating in 2002. CLS provides a PVP service that almost completely eliminates the principal risk associated with settling FX trades. (Box 2 provides a simple example of how CLS works. For more detail, see CPSS (2008) and Galati (2002).) Although there are seasonal fluctuations, use of CLS has grown steadily (Graph 1) and the service is now a well established and critical part of the global financial infrastructure.

Progress has been made ...

Indeed, the 2006 survey showed that CLS has become the primary settlement method for FX trades, with 55% of trades being settled this way (Graph 2). A further 8% was settled by bilateral netting, where two market participants agree that the settlement obligations resulting from all the trades between them due to settle on a given day will be netted against each other so that only the smaller netted amount in each currency needs to be settled.<sup>7</sup> Various other methods accounted for another 5%. However, the key survey finding was that 32% of trades were still settled by traditional correspondent banking – the major source of FX settlement risk.

... but risk remains

This compares to a previous survey in 1997, before CLS was available, when 85% of FX trades were settled by traditional correspondent banking with the remainder settled by other methods including netting. However, although it



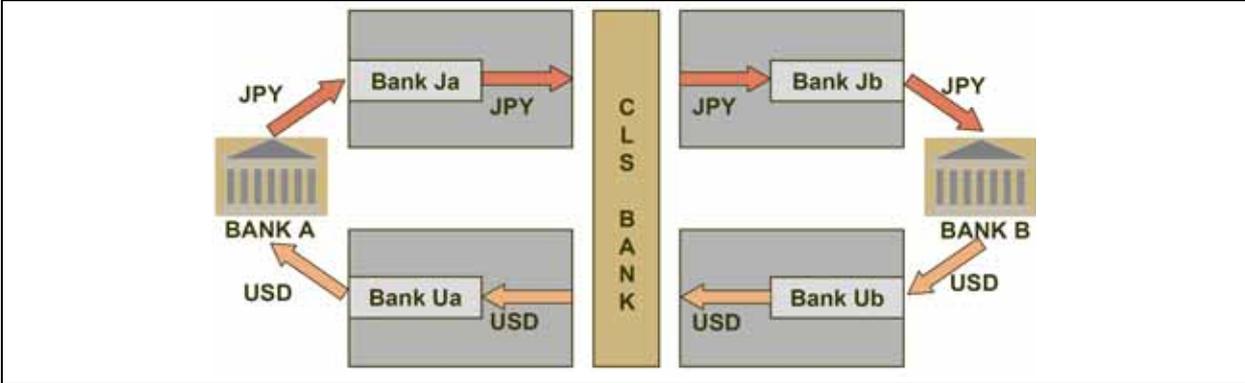
<sup>6</sup> The name “CLS Bank” is derived from “Continuous Linked Settlement”, the brand name of the service provided.

<sup>7</sup> The 8% refers to the size of the reduction achieved. The smaller netted amount will then be settled by another method, typically traditional correspondent banking. (In the survey results, the 32% share of traditional correspondent banking includes any netted amounts settled this way.)

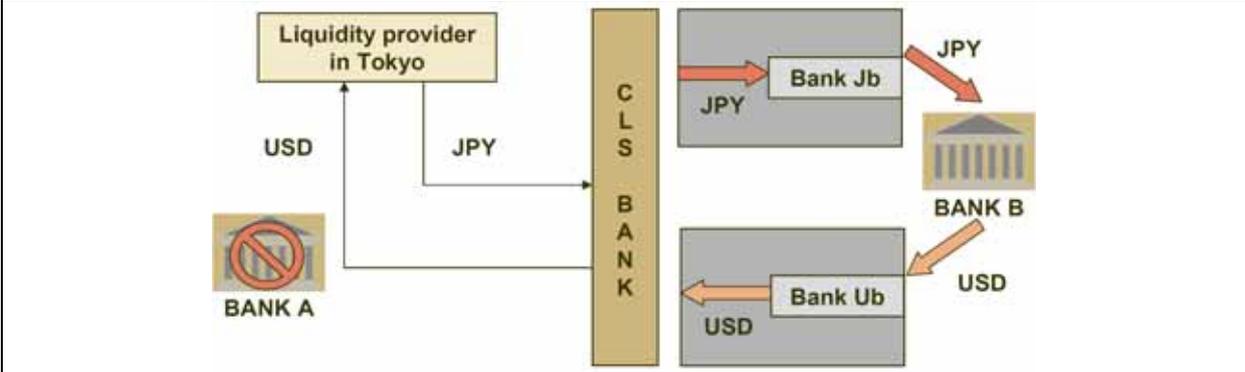
**Box 2: How CLS works – a simplified example**

CLS Bank (CLS) is a limited purpose bank for settling FX, based in New York with its main operations in London. It is owned by 69 financial institutions which are significant players in the FX market. It currently settles trades in 17 currencies, three in North America (Canadian dollar, Mexican peso and US dollar), two in Africa and the Middle East (Israeli shekel and South African rand), six in Europe (Danish krone, euro, Norwegian krone, Swedish krona, Swiss franc and pound sterling) and six in the Asia-Pacific region (Australian dollar, Hong Kong dollar, Japanese yen, Korean won, New Zealand dollar and Singapore dollar).

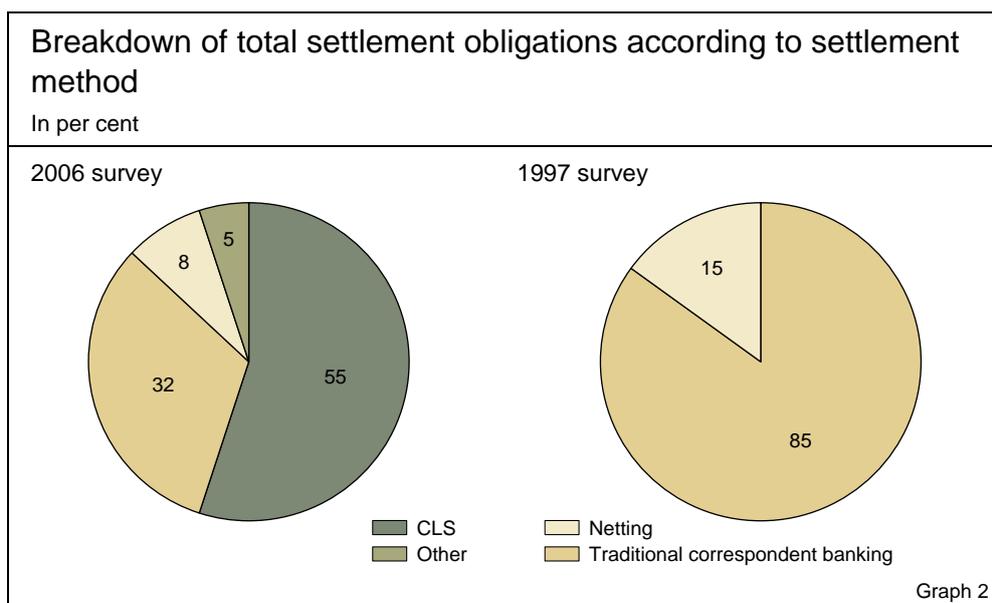
The simple example below, which uses the same yen/US dollar trade as in the previous box, is designed to show the essence of the CLS mechanism in the case of a single trade. In reality, CLS settles a large number of trades between multiple counterparties and has complex risk control mechanisms to enable it to do this safely.



CLS removes principal risk by using PVP – you get paid only if you pay. On settlement day, each counterparty to the trade pays to CLS the currency it is selling – eg by using a correspondent bank, as with the example in the previous box. However, unlike the previous example, CLS pays out the bought currency only if the sold currency is received. In effect, CLS acts as a trusted third party in the settlement process. (However, note that CLS is not a central counterparty – in the example shown, the trade remains between Banks A and B.)



CLS could have been designed so that, if one of the counterparties fails, CLS simply returns the principal amount to the surviving counterparty – in the example, it could return the US dollars to Bank B. However, in practice CLS has committed standby lines of credit with major banks in each of the currencies it settles. In this case, Bank B was buying yen, so CLS will swap the US dollars for yen with its yen liquidity provider in Tokyo, and then give the yen to Bank B. In this way, CLS not only removes principal risk but also reduces liquidity risk. However, the standby liquidity facilities cannot completely remove liquidity risk. The main underlying reason for this is that the liquidity facilities are finite while there is no limit on the total value of the trades that you can attempt to settle via CLS.



is a big reduction from 85%, 32% remains a significant share. Moreover, the values involved are also significant relative to the size of the institutions concerned – on average, equivalent to approximately 70% of their total capital.

### Assessing the remaining exposures

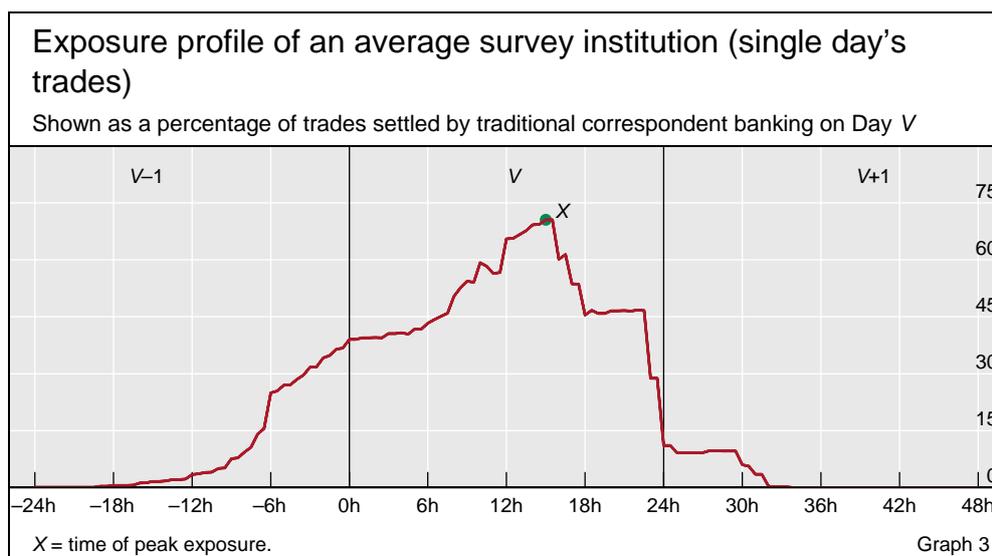
Given that traditional correspondent banking remains a significant method of settling FX trades, the key issue is whether the resulting exposures pose an unacceptable degree of risk. To assess this, the survey asked about the duration and size of survey institutions' total exposures (ie to all their counterparties) and largest bilateral exposures (ie to a single counterparty). It also asked how these exposures were managed.

#### *Total exposures*

The survey showed that the duration and size of total FX settlement exposures can still be significant (Graph 3). Given that, as noted above, FX settlement risk is the risk of paying without being paid, an institution's exposure starts when it becomes irrevocably committed to paying away one of the currencies it is selling. As the graph shows, on average this is at about 06:00 on the day before settlement. As it becomes committed to paying more currencies, its exposure increases. Then at some point, the institution will start to receive the currencies it is buying, causing its exposure to decrease. For a period, its overall exposure may fluctuate as it becomes committed to paying some currencies and receives others. On average, the peak exposure (X) is reached at around 16:00 on settlement day, and the exposure ends when the last currency is received, on average at around 08:00 on the day after settlement.<sup>8</sup>

Total exposures can be large and long-lasting ...

<sup>8</sup> Box 1 explains this process in more detail.



... including overnight

On average, therefore, an institution's exposure to trades due to settle on a particular day actually starts on the day before settlement and continues until the day after settlement – ie the duration is more than 24 hours. This means that an institution using traditional correspondent banking to settle its trades typically always has some FX settlement exposure, overnight as well as intraday. In addition, it means that, for at least part of the day, an institution is exposed to more than one day's trades. Graph 4 shows average exposure during the day allowing for this simultaneous exposure to trades settling on multiple days.<sup>9</sup>

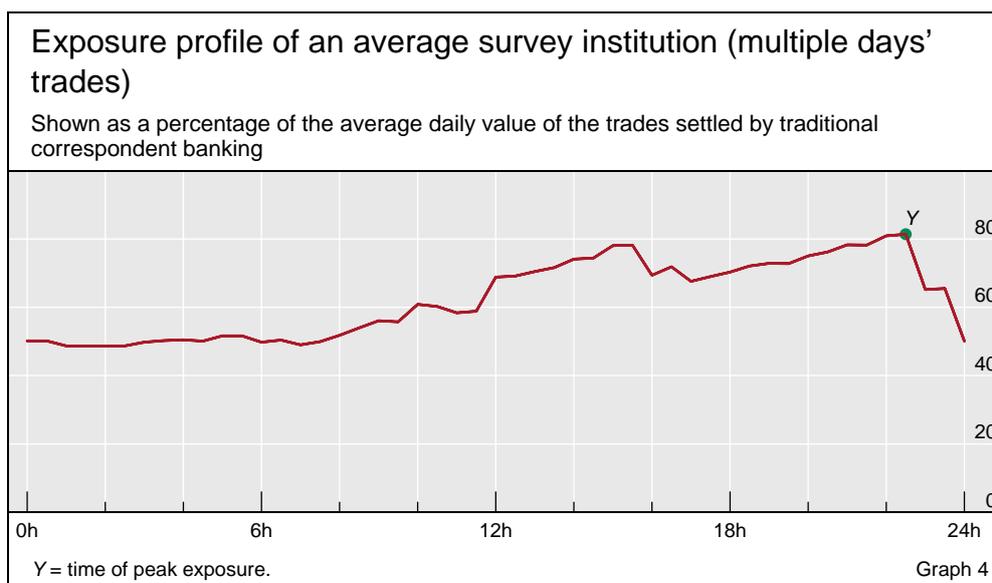
During the period the exposure lasts, the size of an institution's total exposure to all its counterparties varies, as the graphs show, but, on average, peaks at an amount equal to about 70% of the value settled by traditional correspondent banking allowing for one day's trades (ie point X on Graph 3) or at about 80% allowing for simultaneous exposure to multiple days' trades (point Y on Graph 4).<sup>10</sup> Moreover, on the latter, multiple day basis, the exposure is never less than about 50% – even during the night.

Translating these percentages into values for the survey participants overall, the aggregate amount at risk never falls below \$0.5 trillion and peaks at about \$1.1 trillion.<sup>11</sup>

<sup>9</sup> Note that the survey results were daily averages for the survey period. Graph 3 thus shows the exposure profile for the trades settling on one average day (Day V in the graph), while Graph 4 is created by superimposing that exposure profile with identical profiles for trades due to settle on earlier and later average days. In reality, an institution's profile for each day would vary according to the value and type of trades due to settle that day.

<sup>10</sup> The maximum exposures are less than 100% of the value settled primarily because of time zone differences, which mean that (a) some currency pairs generate no exposure (the bought currency is received in an eastern time zone before the sold currency is irrevocably paid away in a western time zone) and (b) the exposure period generated by one currency pair does not always overlap with that of another currency pair (the exposure period for a trade in two eastern currencies may not overlap with that for a trade in two western ones).

<sup>11</sup> The size of the range of the average institution's position in percentage terms (ie 50 to 80%) is different from the range of all survey institutions' aggregate value (ie \$0.5 trillion to \$1.1 trillion) because the exposure profile of the average institution is expressed in its local



An alternative way to judge the size of the total exposures is to scale them by the institution's capital, rather than by the value of the settled transactions themselves. By this measure, an institution's total exposure peaks at 47% and 57% of its total capital on average (single day and multiple day, respectively). In other words, if such exposures were to be shown on an institution's balance sheet (which in practice they are not), they would be a significant item.

Institutions' exposures to FX settlement risk vary for many reasons. For a given institution, exposure can vary substantially from day to day depending on the value and currency composition of the trades. And comparing institutions, the internal procedures of each institution and its correspondents also have a significant effect, particularly on the time at which an institution's settlement exposure in a currency starts.<sup>12</sup> Not surprisingly, therefore, there was very wide variation about the averages just mentioned, with some institutions having negligible exposures while others had exposures as large as six times the size of their capital.

#### *Bilateral exposures*

As noted above, FX settlement risk arises because of the possibility that an individual counterparty will fail to pay. Thus although an institution's aggregate exposure to all its counterparties (its total exposure) is interesting in order to get an idea of the overall scale of the potential problem, more relevant from the point of view of assessing risk are an institution's settlement exposures to its individual counterparties (its bilateral exposures).

Unfortunately, the survey data do not include direct information about the size of bilateral exposures. Nor was it possible to come up with robust *point*

---

time, which has to be translated into a standardised time (eg GMT) when aggregating across institutions.

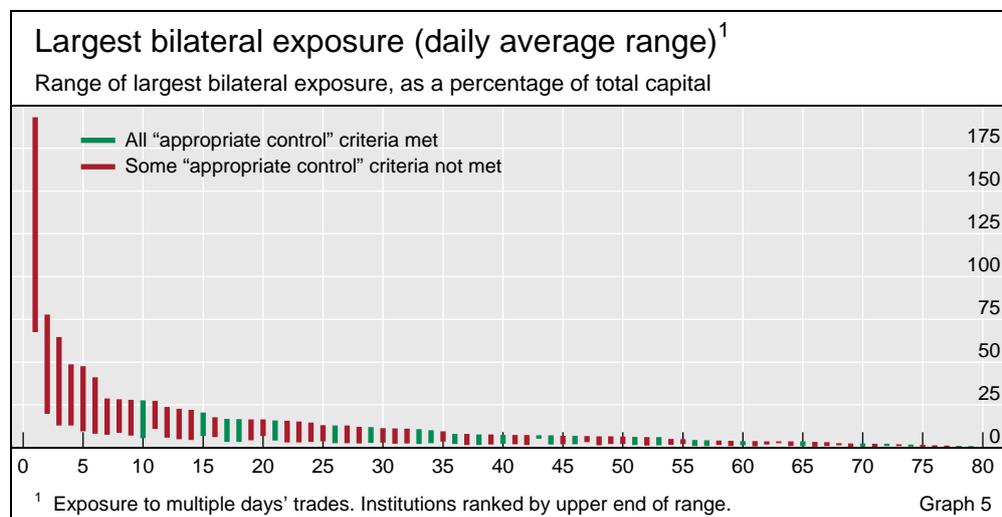
<sup>12</sup> That is, there is variation in the cancellation deadlines, the point at which the institution can no longer cancel the instruction to pay the currency it is selling (Box 1). If an institution and its correspondent bank improve their procedures, they may be able to move back the time at which the exposure starts.

estimates of what those exposures might be. However, in most cases it was possible to produce a robust estimate of the *range* within which an institution's largest bilateral exposure was likely to lie.<sup>13</sup> The results are shown in Graph 5 for the 81 institutions in the survey for which sufficient data were available.

Thus, for example, the largest bilateral exposure of Institution 1, on the left of the graph, is estimated to have been, on average, somewhere between about 70 and 190% of its capital. However, that is an extreme case. For most institutions the range was much lower – for a majority it was entirely under the 10% level. Nevertheless, making some additional assumptions about where within the possible range the actual exposure was most likely to be, more than one in four of the institutions may have had an exposure to a single counterparty greater than 5% of capital, with one in eight being over 10%.<sup>14</sup>

Moreover, these are estimates for an average day; on a peak day, the exposures may have been substantially higher. And in order to get a complete picture of an institution's counterparty exposure, this FX settlement exposure needs to be added to other types of exposure it has to the same counterparty (eg as a result of interbank lending). Given that it would normally be regarded as prudent for a bank to keep its exposure to a single counterparty to no more than a rather small percentage of its capital, the estimates suggest that many institutions continue to have significant bilateral FX settlement exposures which they need to control prudently.

Exposures to single counterparties can also be significant



<sup>13</sup> The survey had data on the aggregate value of an institution's settlement obligations to its five largest and 10 largest trading counterparties and on the breakdown of this value between the various settlement methods. Taking the portion of this aggregate value that was settled by traditional correspondent banking, the ranges were based on estimates of how much or how little of the portion could be accounted for by a single counterparty. More information about the method used to calculate the ranges is given in Annex 3 of CPSS (2008).

<sup>14</sup> These calculations used additional data provided by CLS about the relative sizes of institutions' five largest counterparties, where "largest" was judged by trades settled using CLS, and assumed that the same relative sizes applied to trades settled using traditional correspondent banking.

### *Control of exposures*

However, judged according to three specific criteria, there was a mixed picture about whether the exposures were in practice controlled “appropriately”. The three criteria were whether the institution (1) had established clear senior-level responsibility for managing the exposures, (2) had appropriate daily management procedures (including the use of the same counterparty limits as were applied to other types of similar exposures) and (3) measured the risk in a way that did not lead to underestimation.<sup>15</sup> Although most institutions in the survey met the first two criteria – ie they had established clear senior-level responsibility and many had appropriate daily management procedures – there was still a significant minority (8% and 23%, respectively) that did not. Moreover, most (73%) surveyed institutions failed to meet the third criterion – ie they measured their exposures in a way that at least to some extent underestimated the amounts they had at risk.<sup>16</sup> Indeed, judged overall by these criteria, 66% of the surveyed institutions did not appropriately control their FX settlement exposures – ie only 34% met all three criteria. And as Graph 5 shows, among the institutions with the highest bilateral exposures, the percentage is even lower. For example, of the 10 institutions with the highest exposure, only one was judged to control its exposures appropriately.

Also the exposures are not always appropriately controlled

### **Evaluation of the risk**

Overall, the survey shows that the situation of individual institutions varies considerably. There are some institutions – both large and small – that use PVP services such as CLS as much as they can given the limitations that exist (these limitations are that some trades, including trades in non-CLS currencies and many same day trades, are ineligible for CLS settlement and that CLS cannot be used to settle trades with counterparties that are not themselves CLS users). Some of these institutions also appropriately control any exposures that result from the remaining trades that are settled using traditional correspondent banking – ie they meet the three criteria discussed above. They therefore do all that they can to reduce risk. However, at the other end of the range are institutions that make little or no use of PVP settlement and have significant exposures that are not always well controlled.

The lack of appropriate control is clearly an issue. Financial institutions naturally take many types of risks and this is generally acceptable as long as those risks are well managed – ie understood, properly measured and subject to appropriate controls, such as counterparty limits. From this perspective, the problem is the lack of appropriate management rather than the size of the exposures themselves. There is therefore a choice of solutions. One is for such

One view is that the risk is acceptable as long as it is well managed

---

<sup>15</sup> The three criteria were formulated as objectives. The means by which the objectives were met were not assessed.

<sup>16</sup> Most institutions did not attempt to measure their exposure exactly (as in Graphs 4 and 5) but instead used an approximation method. For example, a common method would be to assume that the exposure existed only on the settlement day. For institutions whose exposures could last for more than one day, this could lead to underestimation of the true position.

institutions to use PVP services such as CLS so that the exposures are avoided. But it is also acceptable for them to continue to use traditional correspondent banking and incur the exposures provided they manage those exposures in an appropriate way.

Another view is that settlement should be risk-free

However, from a different perspective, FX settlement exposures can be seen as intrinsically undesirable, even when they are well managed, because of their possible effects during financial crises. If there is increased market uncertainty – about the financial strength of a counterparty, for example – institutions may prudently decide to reduce their trading limits to that counterparty in order to reduce settlement risk. And, in doing so, they may deprive the counterparty of the market access it needs and thus inadvertently cause it to fail. In contrast, if it was possible to make settlement risk-free, institutions could prudently continue to trade, even in uncertain circumstances. In economic terms, the argument is that the private costs to market participants of removing the risks are outweighed by the social benefits of risk-free settlement.

It is true that, in practice, settlement of any transaction – including FX trades – is rarely, if ever, completely risk-free. This is because even though principal risk can usually be removed by good system design, some liquidity risk typically remains, as is the case with CLS (as noted in Box 2, the reason for this is that, even with the principal amount of the trade being protected in the event of a counterparty failure, CLS cannot fully guarantee that you will receive that amount in the currency you were trying to buy). So the ideal state of risk-free settlement can never be fully achieved. Nevertheless, from this perspective, the risk should be reduced as far as possible. Accordingly, the survey results are of more concern because even well managed FX settlement exposures are not ideal and it would be better if PVP services such as CLS were always used.

## Solutions

Whichever perspective of settlement risk is held, there seem to be two main weaknesses with the current situation which need to be addressed.

There need to be new services ...

The first is that the existing *risk-reducing services* for settling FX trades are not sufficiently comprehensive. The survey showed that over a third of the trades subject to settlement risk were between CLS users but involved types of trades that they currently cannot settle using CLS. As noted above, such trades include same day trades (where the difficulty is that the CLS settlement process takes place too early in the day) and trades in non-CLS currencies. To reduce settlement risk on these trades, either the CLS service needs to be modified or a new settlement service introduced.

The second and perhaps more important weakness is the lack of *incentives* for individual institutions to take action to better manage FX settlement risk. Discussions with survey participants suggest that many FX market participants who have not already taken the necessary action are unlikely to do so unless they are given stronger incentives or compelled to do so by regulatory authorities. The problem is that taking action costs the

institutions money. But at the same time, it seems that the risk is not well understood or is perceived as less serious than equivalent counterparty risks that arise from other activities. Why this should be so is not completely clear – it is perhaps because the exposures are not very transparent. More fundamentally, even if individual institutions were fully aware of the risk to themselves, they would not necessarily take into account the social benefits to the market as a whole of the reduced systemic risk that would result from using safe settlement methods. In any event, there is often a reluctance to spend the necessary money, suggesting that there is a need for incentives or regulatory inducements, both of which are lacking at the moment.

... and stronger incentives to act ...

As far as use of CLS is concerned, certain market-based incentives that some had hoped for (such as smaller spreads on FX trades settled through CLS, recognising the reduced risk involved) have apparently failed to materialise. And although existing CLS users can point to operational savings from the standardised and automated procedures for using CLS, these seem to be outweighed in the minds of many non-CLS users by the size of the fee for using the CLS service. Incentives for addressing the problem through better management of the exposures from traditional correspondent banking are equally lacking. Given this, it is not surprising that many institutions felt that further improvements to the management of FX settlement risk are unlikely unless there is a clear regulatory requirement for them. Particularly important here is action by the banking supervisors. In 2000, the Basel Committee on Banking Supervision (BCBS) issued guidance on managing FX settlement risk. The BCBS and CPSS have recently agreed to work together to review and update the guidance with the aim of setting a higher standard for how banks manage FX settlement risk.

... including regulatory requirements

When publishing the survey results, the CPSS recommended a series of actions to bring about further progress in addressing FX settlement risk (CPSS (2008)). Given the analysis above, two of these actions seem particularly important. One is that CLS or other industry groups should continue to develop services to reduce FX settlement risk, particularly services for same day trades and trades involving additional currencies. The other is that central banks should work with banking supervisors and other regulators to explore ways to encourage market participants to manage their settlement risks better. For example, regulators could require FX settlement risk to be managed and controlled in the same way as other formal short-term credit extensions of similar size and duration (eg unsecured overnight interbank loans).<sup>17</sup> Success in implementing these two actions will be key to determining whether the potential threat of FX settlement risk to the stability of the global financial system can finally be removed.

---

<sup>17</sup> Another possibility that is sometimes proposed is to put a capital charge on the exposures.

## References

Bank for International Settlements (2007): *Triennial central bank survey of foreign exchange and derivatives market activity in 2007*.

Basel Committee on Banking Supervision (2000): *Supervisory guidance for managing settlement risk in foreign exchange transactions*.

Committee on Payment and Settlement Systems (1996): *Settlement risk in foreign exchange transactions*.

——— (2008): *Progress in reducing foreign exchange settlement risk*.

Galati, G (2002): "Settlement risk in foreign exchange markets and CLS Bank", *BIS Quarterly Review*, December, pp 55–9.