The relationship between the overnight interbank unsecured loan market and the CHAPS Sterling system

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This article uses data on CHAPS Sterling transactions to describe the segment of the unsecured overnight loan market that settles within CHAPS. It assesses the size, timing and importance of these transactions for the underlying payments infrastructure. Advances and repayments of overnight loans are estimated to have accounted for around 20% of CHAPS Sterling activity by value over our sample period; four CHAPS Sterling members send and receive virtually all payments corresponding to these loans; and, finally, the value of CHAPS Sterling payments associated with this market rises towards the end of the CHAPS day.

Introduction

This article uses data on transactions processed in the Clearing House Automated Payment System (CHAPS Sterling) to provide a description of the segment of the sterling interbank overnight unsecured loan market that settles within CHAPS. In particular, we examine the size of this market, the costs of these loans and the timing of settlement of these loans. In addition, we consider the implications of these payments for the system through which they are made.

Whether a loan is brokered or is the result of a direct deal between two financial institutions, it will eventually result in a payment from one bank to another. Unless the two involved financial institutions are customers of the same settlement bank (in which case the transaction may be settled on the books of the settlement bank) this will be settled in CHAPS Sterling. The Bank of England operates the CHAPS system and keeps a record of all transactions among the settlement banks for surveillance and research purposes.(1) Here, we use this information to match the two legs of an unsecured overnight loan as the payment and repayment are made across CHAPS Sterling.

We find that around £22 billion of overnight interbank loans are processed across the CHAPS Sterling system every day. This represents a large proportion of total CHAPS Sterling activity; in particular, we estimate that 22% of all CHAPS Sterling transactions by value are advances or repayments of overnight loans. Although there are 13 settlement banks (including the Bank of England) in CHAPS Sterling, we find that four members send and receive virtually all payments corresponding to overnight loans. Finally, we find that the value of CHAPS Sterling payments associated with this market increases as the day progresses.

Data

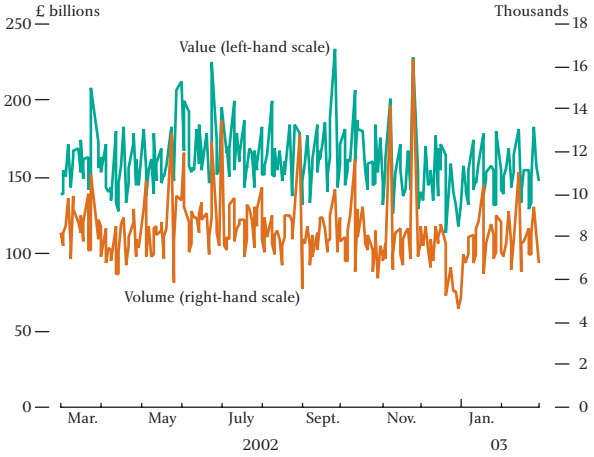
The Bank of England keeps track of all CHAPS Sterling transactions that occur among the settlement banks.(2) We use data from 4 March 2002 to 4 March 2003. Removing weekends, holidays and the one day on which the system encountered operational problems leaves 252 days of data. The average total daily CHAPS Sterling value was around £200 billion over the sample period. Though CHAPS is designed to handle large-value payments, it is common to find small-value transactions as well. We consider only payments of value larger than £1 million. We also exclude those payments where one of the sides is known to be a non-bank customer of a bank and consider only transactions that occur among banks.(3) Finally, CHAPS Sterling involves a total of 13 banks but we ignore transactions involving the Bank of England and, though NatWest and RBS still run separate accounts in CHAPS,

(1) An example of published work is James, K (2003), 'A statistical overview of CHAPS Sterling', *Financial Stability Review*, June, pages 115–21.
(2) We exclude movements of money into and out of CREST and, hence, ensure that we do not pick up secured loans that settle in CREST, such as 'delivery by value' trades (DBVs).
(3) We do this by using part of the SWIFT message attached to each transaction. This will still leave some non-bank transactions; in particular, our data will include payments made on behalf of non-bank customers of correspondent banks. But this is unlikely to affect our results in a material way.

we merge their accounts and consider them as a single group.

With these criteria in place, we were left with CHAPS Sterling payments averaging £155 billion a day (about 7,900 payments). Chart 1 depicts the value and volume of the selected payments while Table A reports the mean and standard deviation for total volumes and total values.

Chart 1
CHAPS Sterling volume and value



Source: Bank calculations.

Table A
CHAPS Sterling volume and value

	Volume (000s)	Value (£ billions)
Mean	7.9	155.2
Standard deviation	1.7	23.7

Source: Bank calculations.

Method

An overnight interbank unsecured loan involves one bank entering into an agreement to borrow from another bank a sum, K, with the promise to repay the following working day an amount equal to this sum plus interest, $K(1 + r)$, where r is the overnight interest rate. Provided that the two banks are not customers of the same settlement bank and the trade is not settled on its books, both legs of the transaction will appear as CHAPS Sterling payments. So it should be possible to see both the loan advance and the repayment within data on CHAPS payments. In what follows, we apply the method developed by Furfine (1999) in order to identify pairs of payments made in CHAPS Sterling on consecutive days that are associated with overnight loan advances and their repayment.(1)

The basic intuition underlying the algorithm is simple: it looks for pairs of payments on consecutive days that look as if they may be loans. More specifically, it looks for payments from A to B on day t that are 'slightly larger' than round-valued payments from B to A on day $t - 1$. The idea is that loans are made in round values and that the 'slight difference' in the payment size represents the interest paid on the loan. For each pair of payments, V_1 and V_2, say, the algorithm calculates the implied annualised interest rate, $\frac{V_2 - V_1}{V_1} * 365$, and if this looks 'reasonable', which we define as being in the interval 3% to 6%, then the payments are logged as the advance and repayment of an overnight unsecured loan.(2)

We select a band of between 3% and 6% as it encompasses the repo rate—which was 4% for most of the sample period—and ensures that we consider only overnight loans as opposed to loans made for a longer duration.(3) To see this, consider a loan for £1 million made on day t over two days at an annualised rate of 4%. The repayment would be £1,000,219 on day $t + 2$. Now if there were a payment from the lending bank to the borrowing bank of £1 million on day $t + 1$, our algorithm would consider it as a possible overnight loan made on day $t + 1$. But the implied interest rate of 7.99% would be outside our band and so the pair of payments would be rejected. This would be the case for any loan of maturity longer than one day whose interest rate was between 3% and 6%.

More specifically, the precise algorithm used to identify the payments (at date $t - 1$) and the repayments (at date t) works as follows:

(1) At date t, round all payments down to the nearest hundred thousand figure. For example, £251,345,891.54 is approximated by £251,300,000.00. In other words, we start by assuming that all non round valued payments on day t are potential repayments of overnight loans and we calculate the values of the advances that we

(1) Furfine, C (1999), 'The microstructure of the Federal Funds market', *Financial Markets, Institutions and Instruments*, Vol. 8, No. 5, pages 24–44.
(2) As a reality check, we found that, although there appeared to be some loans made at less than 3% or more than 6%, relaxing either of these bands did not change significantly either the total size or the average cost of our identified set of loans.
(3) It is important to be sure that we are identifying only overnight loans, since in the United Kingdom, unlike in the US Federal Funds market where Furfine (*op cit*) applied the algorithm, there is an active interbank loan market at many points in the maturity spectrum other than overnight.

would wish to look for on day $t - 1$ that would correspond to such repayments.

(2) Compute the implied interest rate, r, using the simple rate rule. In our example, r = (£251,345,891.54/£251,300,000.00 – 1) *365 = 0.0667. We do this in order to eliminate some of the payments identified as possible repayments of overnight loans in Step (1) on the grounds that such repayments would imply an interest rate that was either too high or too low to be 'reasonable'.

(3) If the implied rate, r, lies between 3% and 6%, select the rounded payment and the associated rate, otherwise exclude the payment. Having excluded these payments we are left with a set of possible repayments and a set of associated advances (the rounded payments) that we now wish to look for on day $t - 1$.

(4) Check if the selected advances left after Step (3) can be found among the payments at day $t - 1$. If the answer is yes, then this payment is considered to be the advance of an overnight loan and its associated payment on day t the repayment of this loan, otherwise it is discarded. Given this approach, we will only pick up overnight loans as opposed to loans of two or more days' maturity, since, unless the payment can be matched to one made the previous day, it is dropped.

(5) Repeat Steps (1)–(4) for all payments for each pair of banks and for each pair of consecutive business days.

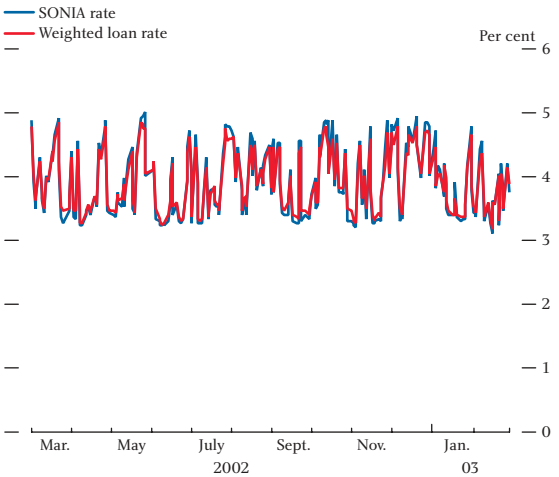
The algorithm assumes that the principal and the interest are repaid together as one CHAPS Sterling transaction. Furfine suggests that in Fedwire it is possible to pay the principal and the interest separately, that is, as two payments.(1) Also, we use a first in, first out (FIFO) rule for the timing of the payments and repayments. This means that the first loan is assumed to be the first one repaid the day after. Finally, our algorithm will catch overnight loans that are negotiated on previous days, ie forwards. But this will not affect any of our conclusions with respect to the volumes and timings of payments associated with such loans.

Have we identified overnight unsecured loans?

In order to identify overnight unsecured loans, we have not explicitly used the intraday quoted overnight rates. So we can evaluate how good our method is by comparing the rates of interest charged on what we identify as loans with quoted overnight rates. Of course, even if we perfectly identify unsecured overnight loans, our rates will still differ slightly from quoted rates because quoted rates are only indicative and may differ from the actual rates applied to the transactions. In addition, there may be a significant time lag between when the loan is agreed and when the payment is transferred over the CHAPS Sterling system.

We have computed both a simple arithmetic average of the rates we calculated and an average weighted by the value of the loans, and these look similar to each other. In Chart 2, we compare our weighted average with the sterling overnight indexed average (SONIA) rate.(2) They are close, with our rate averaging 3.87% and the SONIA rate averaging 3.89% over the same period of time, a difference of only 2 basis points. Moreover, the correlations between the daily level of the SONIA and the daily average level of interest rates that we calculate, and between changes in the levels of these interest rates are both high, at 0.97 and 0.94, respectively. This evidence strongly suggests that our algorithm has been successful in identifying overnight unsecured loans.

Chart 2
Weighted average daily loan rate and SONIA rate



Source: Bank calculations.

(1) The Fedwire Funds Service is a real-time gross settlement (RTGS) payment system in the United States.
(2) The SONIA rate is the weighted average rate of all unsecured sterling overnight cash transactions brokered in London by Wholesale Markets Brokers' Association (WMBA) member firms between midnight and 4.15 pm with all counterparties in a minimum deal size of £25 million.

Caveats

There are several reasons why our data set and method will not be able to detect all activity in the overnight interbank market, but rather only a subset of it. First, as the CHAPS system records only transactions between settlement banks, a loan between two correspondent banks that use the same settlement bank may not be picked up in the database.

A second qualification is related to foreign exchange (FX) swap operations where one side of the transaction is typically adjusted for the interest rate differential between the two currencies, while the other side remains unchanged. So, if we had an FX swap transaction in which the sterling leg is adjusted for the interest rate differential and this differential fell within our 3% to 6% range, then our algorithm would identify such a swap as an unsecured loan. At face value, the effect of this could be significant. But, in practice, the effects are likely to be much smaller.

In ¥/£ swaps, the yen leg is typically fixed. We used the Bank of Japan's unsecured overnight call rate as a proxy for the actual overnight rates charged. Given that its average in 2002–03 was 0.002%, it is possible that some of the loans we identify are sterling/yen swaps. But the value of sterling/yen swaps of maturities less than one week was small, about £280 million, and so the value of overnight sterling/yen swaps is likely to be smaller still.

In €/£ swaps, the euro leg is usually fixed. During 2002 and 2003, the interest rate differential between the sterling Libor and the EONIA rate was small, averaging 78 basis points and peaking at 210 basis points.(1) Since we have used a 3% to 6% band to identify possible overnight loans, it is unlikely that sterling/euro swaps are included in our data set.

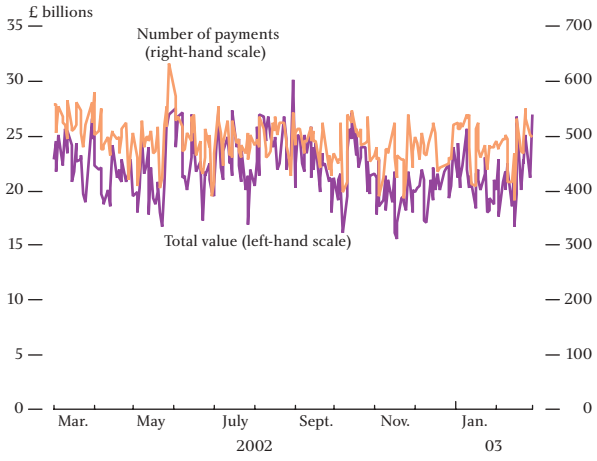
In $/£ swap operations, the sterling leg is usually, but not always, fixed. So, in principle, we should not pick them up in our data set. Nonetheless, given the large volume of activity in $/£ swap operations, it is worth checking whether some transactions we identify as unsecured loans are in fact legs of FX swaps. Over the sample period, the average spread between the sterling Libor and the federal funds rate was 234 basis points, and it was above 300 basis points on many days. An indirect way to check whether we identify some of these swap transactions as unsecured loans is to compare our identified average daily total loan value on days when the sterling/dollar interest rate spread is greater than 3 percentage points—which might lead our algorithm to identify swaps as unsecured loans—with that on days when the spread is smaller than 3 percentage points. We would then expect the average daily value of loans we identified to be larger when the spread was greater than 3 percentage points. In fact, we found the opposite. This suggests that we are not often identifying sterling/dollar swap transactions as unsecured overnight loans.

Results

Size of the market

Applying our algorithm and keeping in mind the previous caveats, we identify unsecured overnight loans averaging about £22 billion daily from our data set. Chart 3 depicts the daily total volumes and values for the loans we identify while Table B gives summary statistics. We find that about 11% of the £200 billion daily average value of CHAPS Sterling payments

Chart 3
Total loan volume and value



Source: Bank calculations.

Table B
Payments in CHAPS Sterling representing advances of unsecured overnight loans

	Volume	Value (£ billions)
Mean	486	21.7
Standard deviation	38.3	2.6

Source: Bank calculations.

(1) The BBA Libor overnight fixing is a measure of the interest rate at which banks borrow funds from other banks in the London interbank market reported to the BBA at 11 am by a panel of banks. The EONIA rate is the effective overnight reference rate for the euro area. It is computed as a weighted average of the rates charged on all overnight unsecured lending transactions undertaken in the interbank market, initiated within the euro area by banks contributing to its construction.

represents advances of overnight unsecured loans. If we also include repayments, the figure rises to 22% of total CHAPS Sterling flows.

The Wholesale Markets Brokers' Association (WMBA) collects data on unsecured sterling overnight cash transactions brokered in London, essentially the same segment of the money market we are considering. Using their pre-June 2003 definition, the average daily volume of brokered overnight loans for our sample period was around £12 billion, which, when compared with our figures, would be consistent with anecdotal evidence that roughly half of this market is brokered while the rest takes place through direct contacts.(1) There is one caveat to this, however. We detect only transactions within CHAPS Sterling. If a brokered deal is settled between two correspondent banks that have the same settlement bank or between a correspondent bank and its own settlement bank and if that deal settles within the settlement bank's own books, then this would be recorded in the WMBA series but not in ours.

Market participation

From a financial stability perspective, it would be desirable to determine the most active players in this market. But from the available information only the identity of the settlement banks can be tracked. So it is possible to know that a certain CHAPS bank has made a payment to another direct member, but we do not know the final identity of the payer and of the payee. Without additional information, we can draw conclusions only on the operational role played by the settlement banks in sending and receiving the loans on behalf of their clients. This does not imply that the settlement banks are not themselves involved in the overnight loan market (they are), but rather that it is not possible to derive their level of direct participation.

We find that four CHAPS Sterling members send and receive virtually all payments corresponding to overnight loans. So an operational disruption to any of these four banks, to the extent that the ultimate lenders and borrowers could not switch settlement bank quickly in time, could impair the functioning of the overnight interbank market.(2)

Time distribution of payments connected to overnight lending

One important risk to a payment system is that of an operational failure. The impact of any such event—whether it affects individual settlement banks or the whole system—will depend upon what payments still need to be settled on the day the event occurs. From the point of view of the system operators, the effect of a given operational event will be larger the more payments that remain to be settled after the event has occurred (since they may have to find alternative means of processing them). From the point of view of the participants, on the other hand, the effect of a given operational event will be to leave some banks overdrawn with their settlement banks (since loans they had negotiated to square off their positions would not come through). In turn, if there were no robust arrangements for dealing with such contingencies, these settlement banks would be unable to clear their intraday overdraft with the Bank of England and this would result in them being left with an overnight overdraft, potentially charged at a penal rate. And the problem is likely to be worse the higher the value of payments remaining to be settled, suggesting that the higher the value of payments settled late in the day, the more important it is to have robust arrangements for dealing with such contingencies.

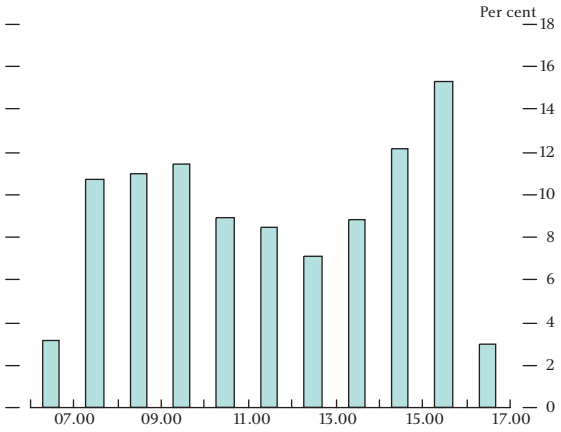
Using the time stamp associated with each payment, we can derive the fraction of the total value and volume of loans that is settled (as opposed to agreed) in each time interval and, thus, assess the effect of operational risk in the CHAPS Sterling system in respect of overnight loans.

Chart 4 depicts the average time distribution over the sample period by number of payments made in relation to loans being advanced through the system (that is, not including repayments). Chart 4 suggests that payments made in CHAPS Sterling associated with advances of overnight unsecured loans are fairly evenly spread throughout the day with roughly 11% of payments made in each hour between 7 am and 10 am, 12% between 2 pm and 3 pm and 18% between 3 pm and 5 pm. So an operational failure at 3 pm that was not corrected by the end of the CHAPS day would probably leave fewer than 100 payments resulting from interbank loans for the

(1) On 2 June 2003, after extensive consultation, the WMBA broadened the definition of qualifying transactions used in the calculation of the SONIA rate. The calculation had previously been based only on interbank transactions. This has now been extended to all sterling overnight cash transactions with a minimum size of £25 million, irrespective of counterparty status. See 'Markets and operations' (2003), *Bank of England Quarterly Bulletin*, Summer, page 159.

(2) Wells, S (2002), 'UK interbank exposures: systemic risk implications', *Financial Stability Review*, December, analyses how interlinkages among banks may provide a channel through which financial difficulties in an individual bank can be propagated to other banks.

Chart 4
Time distribution of loan advances made through CHAPS Sterling by volume

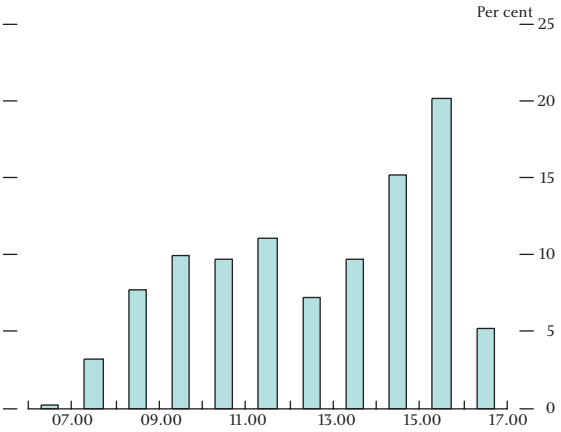


Source: Bank calculations.

system operators to sort out.(1) This suggests that the overnight interbank loan market does not greatly increase the impact of an operational event in CHAPS Sterling at the moment, at least from the point of view of the system operators.

Chart 5 shows that the fraction of payments made in relation to loans being advanced (again, as opposed to repaid) through the system by value rises in the morning; there is a hiatus around lunchtime; and then it rises again throughout the remainder of the CHAPS Sterling day which ends at 4.20 pm. Indeed, 25% of these payments by value are effected during the last hour and a half of the CHAPS day. This concentration of payment transfers associated with loans underlines the importance of robust systems at the settlement banks and the Bank of England, as well as the importance of robust contingency arrangements such as those that CHAPS has sought to put in place.(2)

Chart 5
Time distribution of loan advances made through CHAPS Sterling by value



Source: Bank calculations.

Conclusions

In this article, we have provided a description of the segment of the sterling overnight unsecured loan market that settles within CHAPS Sterling. We found that payments associated with overnight loans represent a large proportion of CHAPS Sterling flows. In particular, around 22% of all CHAPS Sterling transactions by value represent advances or repayments of overnight loans. This suggests that any change in the size of the overnight loan market could have a large impact in terms of the total value of payments flowing through CHAPS Sterling.

Although there are 13 settlement banks in CHAPS Sterling (including the Bank of England), we found that four members send and receive virtually all payments corresponding to overnight loans.

Finally, we found that CHAPS transfers representing advances of overnight unsecured loans are spread fairly evenly over the CHAPS Sterling day by volume, but increase in value over the course of the day. This underlines the importance, recognised by CHAPS, of both the settlement banks and the payment system having robust arrangements to deal with operational disruption late in the day.

(1) 18% of the 486 payments made on average through the CHAPS Sterling system that represent advances of loans would equal 87 payments. (See Table B.)
(2) In practice, CHAPS has developed a set of robust procedures for dealing with such contingencies. For example, the 'Stricken bank scheme' enables the system to deal with cases of operational failures at individual settlement banks and 'Bypass mode' gives the system operators a means of ensuring that payments can be made even if the RTGS central system experiences a serious failure.