

Collateral posting decisions in CHAPS Sterling

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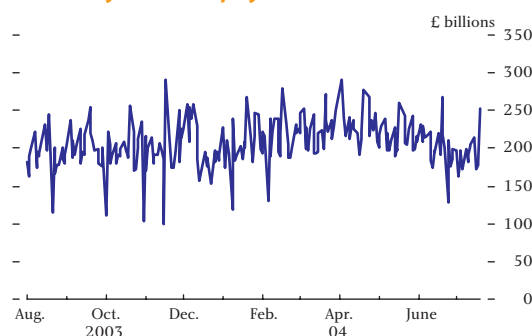
The smooth functioning of payment systems, and in particular large-value payment systems, is important to maintaining financial stability. In the UK, the CHAPS Sterling system allows banks to make real-time sterling payments on their own behalf or on behalf of their customers. CHAPS Sterling member banks support their payments activity in CHAPS Sterling by borrowing intraday from the Bank of England. A member bank can borrow from the Bank of England if it posts collateral. But member banks post much more collateral than they appear to need to support their payment activity. As a result, CHAPS Sterling should be robust to operational incidents that temporarily prevent a member bank from making payments. A possible explanation for member banks posting more collateral than they need is that the costs of posting collateral are less than the cost of failing to make timely payments. The empirical evidence is consistent with this explanation.

BANKS wishing to make real-time sterling payments either on their own behalf, or on behalf of their customers, use the CHAPS Sterling payment system.¹ The total value of payments settled is very large, with CHAPS Sterling handling on average approximately £200 billion of payments every day (Chart 1). CHAPS Sterling is used to make various types of payments. For example, a consumer may use it to buy a house, or a bank may use it to repay an overnight interbank loan. A disruption to the smooth functioning of CHAPS Sterling would affect the ability to make timely payments, which in turn might lead to the disruption of economic activity that depends upon timely payments being made (such as the interbank loan market).

The possible consequences of such a disruption have led researchers at the Bank of England to examine the resilience of CHAPS Sterling to events that temporarily prevent a member bank from making payments.² These studies have found that CHAPS Sterling is highly robust to such disruption. This robustness arises in large part because CHAPS Sterling member banks individually post more collateral with the Bank of England than they generally need to support their payment activities. While the fact that member banks behave in this

manner is undoubtedly good for system robustness, why they behave in this way demands explanation. In this article we explore why CHAPS Sterling member banks choose to post the amount of collateral they do.

Chart 1
Total daily value of payments settled in CHAPS Sterling



Source: MID payments database.

The role of collateral in CHAPS Sterling

CHAPS Sterling is a Real-Time Gross Settlement (RTGS) payment system. In the CHAPS Sterling system, a given member bank A can make a payment of £x to another member bank B only if its available cash at the time at least equals £x. If a member bank can make the payment, it is made immediately – the

(1) Although there are only twelve banking groups that are direct members of CHAPS Sterling, all UK resident banks (and so their customers) have access to CHAPS Sterling through (direct or indirect) correspondent relationships with member banks. Payments between CHAPS Sterling member banks and banks that are not direct members, and payments between banks that are not direct members but have a correspondent relationship with the same member, are settled across the accounts of CHAPS Sterling members rather than in the CHAPS Sterling system itself.

(2) See, for example, James (2005) and Bedford, Millard, and Yang (2004).

Bank of England deducts £x from A's account and credits £x to B's account – and with finality. Each payment instruction is settled sequentially and in gross terms (ie payments from A to B and from B to A made at the same time are not netted against one another).

A member bank's available cash at a given time T equals the sum of the value of (eligible) securities it has repoed to the Bank of England before T and net payments the member bank has received by T. As a shorthand, we use the term 'posting collateral' to describe the process by which a member bank puts cash into its CHAPS Sterling account by repoing securities to the Bank of England.¹ To illustrate: if at T a member bank has £100 of collateral posted, and if in the period between the start of the day and T it has made payments of £50 and has received payments of £75, then its available cash at T equals $£100 + (£75 - £50) = £125$. It follows that at T, the member bank could make payments with a value up to £125. If it did so, it could not make any further payments until either it posted further collateral with the Bank of England or it received a payment from another member bank.

As a member bank's available cash is the sum of the collateral it posts and the net payments it receives, a member bank can use incoming payments to provide the cash it needs to make its payments. A member bank need only draw upon the cash it obtained by posting collateral to make payments at a given time if the value of payments it has made up to then is more than the value of payments it has received.

The difference between the value of payments received and the value of payments made is equal to the member bank's settlement account balance at the Bank of England. So, the amount of collateral a bank must post to enable it to make its payments on a given day will equal the maximum overdraft on its settlement account during that day. When we say that banks post more collateral than they use, we mean that the amount of collateral that a bank posts exceeds the maximum overdraft on its settlement account.

To illustrate: consider the following pattern of incoming and outgoing payments. At T_1 , the bank

receives a payment of £50 and does not make any payments of its own. At T_2 , the bank makes a payment of £25 leaving it with £25 in its settlement account. At T_3 , the bank receives another £100 payment leaving it with £125 in its settlement account. At T_4 , the bank wishes to make a payment of £200. Making it will result in an overdraft on the bank's settlement account of £75. For this payment to go through, the bank must have posted at least £75 of collateral before T_4 ; if not, it would have lacked the amount of cash it needed to make the T_4 payment.

As payment activity redistributes cash across member banks, it is at least possible for a significant proportion of total system cash to end up at a single member bank at some point in time. During normal times, interbank payment flows tend roughly to balance out, so if net payment flows to bank A had been high prior to time t, then net payment flows from A would tend to be high after time t. However, if A were to suffer an operational problem that prevented it from making payments at a time when it had absorbed a significant proportion of total system cash, this redistribution could not occur through this normal payment activity. Without additional postings of collateral, the remaining member banks would have to support their payment activities with the (smaller) amount of cash they had in their accounts. If the amount of cash remaining in the accounts of the functioning banks were too small, the flow of payments may be disrupted. For example, consider the extreme case in which a single bank has received payments from the remaining banks that equal all of their available cash and then suffers from an event that prevents it from making payments. In this case no other member bank could make a payment until the problem bank made a payment, or until the other member banks posted additional collateral.

The probability that a member bank finds itself with insufficient cash to enable it to make its payments decreases as the amount of collateral it posts increases. In the limit, if a bank were to post collateral equal to the total value of payments it wished to make, then it would have the available cash needed to make all those payments, even if no other

(1) To post collateral, a CHAPS Sterling member bank will repo eligible securities to the Bank of England, and the Bank of England will in turn credit the bank's account with an amount equal to the value of the repoed securities (minus a haircut). The repoed securities serve as collateral for the account deposit, ensuring that payments made are backed by good funds. The repo is unwound at the end of the day, and the Bank of England acts as the custodian for the securities overnight. The process can then be repeated the next day.

bank sent a payment to it. If a member bank posts more collateral than it needs given normal conditions, it will have a cushion of available cash that it can use in the case of an operational event that temporarily reduces the flow of incoming payments from other member banks.

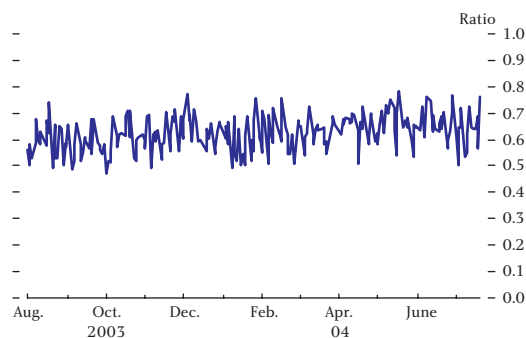
For example, to return to the illustrative case above, suppose that an operational disruption prevented the bank from receiving the £100 payment in T_3 . In this case the maximum overdraft on its settlement account, if it made all its payments, would be £175. If the bank had posted collateral just equal to the £75 it needed in normal times (no operational disruption), it would not have been able to make its T_4 payment unless it posted additional collateral. However, if the bank had initially posted enough collateral over and above what it needed in normal circumstances (say £200), then the operational disruption that prevented the T_3 payment from arriving would not hinder the bank's ability to make its T_4 payment.

Banks in CHAPS Sterling generally post more collateral than they use. Chart 2 shows the ratio of the maximum level of collateral used to the maximum level of collateral posted during the day for the average CHAPS Sterling member bank. This ratio averages about 0.6.¹ That is: on average, banks use only 60% of the collateral they post.² Chart 3 shows overall collateral usage in CHAPS Sterling by plotting total collateral for all member banks and total collateral used for the system as a whole. Again, total collateral posted exceeds total collateral used.³

Charts 2 and 3 suggest that CHAPS Sterling could continue to function smoothly even in the face of an operational event that temporarily deprived banks not directly affected of incoming payments. Bedford, Millard, and Yang (2004) investigated this hypothesis by using simulations based on CHAPS Sterling payment flows. In particular, they explored the extent to which an operational event preventing the member bank with the largest net payment inflow from making

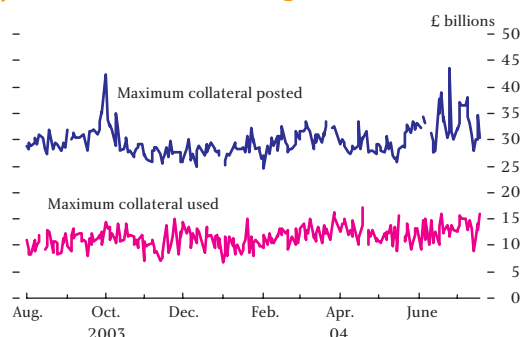
payments would disrupt the ability of the remaining member banks to make payments. They found that functioning banks still had the cash available to make all the payments they had in fact made.

Chart 2
The ratio of maximum collateral used to maximum collateral posted



Source: MID payments database.

Chart 3
Maximum collateral used and maximum collateral posted for CHAPS Sterling as a whole



Source: MID payments database.

CHAPS Sterling member banks benefit collectively from the resilience that high collateral postings create. However, it is harder to see why any individual bank finds it worthwhile to post the collateral needed to ensure this system-wide resilience. First, the probability of such an event occurring is small. Second, much of the cost of any disruption may be borne by banks' customers rather

- (1) There are complications in measuring collateral posted and used in CHAPS Sterling because CHAPS Sterling also serves as a gateway to the CREST securities settlement system. Banks use CHAPS Sterling to transfer cash they use to support securities settlement in CREST. As this cash is only temporarily held in CHAPS Sterling it does not make sense to include these transfers when calculating the amount of collateral posted and used in CHAPS Sterling. We therefore measure collateral posted in CHAPS Sterling as total collateral posted minus the transfers to CREST. We also adjust collateral used in CHAPS Sterling to take account of transfers to CREST. It is also possible to simplify the measurement of collateral posted because banks do not normally vary significantly the amount of the collateral posted during the day. We take as our measure of collateral posted the amount of collateral posted at 7 am (after the CREST transfers) which is before most CHAPS Sterling payments are made.
- (2) The ratio between the maximum level of collateral used and the maximum level of collateral posted varies across banks and over time. However, in our sample, only one CHAPS member consistently uses nearly all of its posted collateral. For most member banks, the ratio rarely exceeds 90%.
- (3) The ratio of collateral used to collateral posted for the system as a whole is lower than the average of collateral used to collateral posted for individual banks because banks do not all hit their point of maximum collateral usage at the same time.

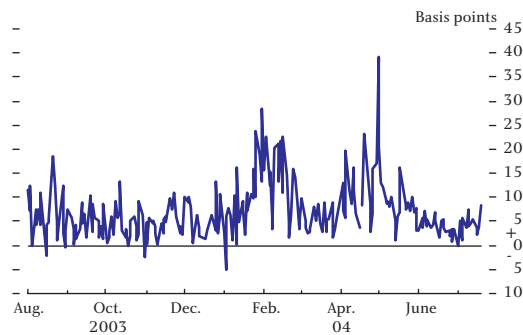
than by the banks themselves. And third, each bank individually would tend to prefer that other banks post the extra collateral needed to keep the system functioning, if collateral posting has a cost. So why might member banks find it privately worthwhile to post more collateral than they generally use?

The costs and benefits of posting collateral in CHAPS Sterling

A bank can obtain collateral to post with the Bank of England (ie eligible securities) through different channels. First, a bank may already have eligible securities outright on its books. In this case a bank can simply repo those securities to the Bank of England. A second channel, if a bank lacks eligible securities on its books, is for it to borrow money on the interbank loan market, use that money to reverse-repo in eligible securities and then repo those securities to the Bank of England.

The opportunity cost of obtaining collateral through the reverse-repo channel equals the cost of obtaining an interbank loan minus the rate the bank gets by lending the money out again through reverse-repo. We assume that banks can borrow at the London Interbank Offered Rate (Libor) and that they can lend at the secured-lending repo rate.¹ The cost of obtaining eligible sterling-denominated securities through this channel thus equals Libor minus the repo rate. A bank with eligible sterling-denominated securities could, instead of using them as collateral, use those securities to borrow money at the secured lending repo rate and then lend that money on the interbank market at Libor. It follows that a bank that uses existing sterling-denominated eligible securities forgoes a return equal to Libor minus the repo rate. So, one measure of the opportunity cost of posting collateral equals Libor minus the repo rate.² Using overnight Libor and repo rate data from the British Bankers Association, the spread averages around seven basis points over the period (Chart 4).³

Chart 4
The overnight Libor/repo rate spread



Source: BBA.

So far we have discussed the costs of posting collateral. The benefit of posting additional collateral is that member banks can avoid the costs associated with delaying or cancelling payments. We can measure this benefit as the probability that the bank uses the marginal unit of collateral to make a payment multiplied by the cost that would have been associated with being unable to make that payment or only making it with a delay. For example, these costs might result from a bank failing to provide time-sensitive payment services to its customers; not meeting its CLS payment obligations on time⁴; or failing to satisfy throughput guidelines.⁵ Given the cost of posting collateral and an assumed cost of delaying and cancelling payments, one can then determine how much of a collateral buffer it would be worth a member bank posting.

Consider the marginal costs and benefits of posting an additional £1 million of collateral. If the opportunity cost of posting collateral equals seven basis points, then the cost of posting this collateral for one year equals £700. If the loss the bank suffers from being unable to make a payment equals 1% of the value of that payment (£10,000 for the £1 million of collateral), then the bank would be willing to post a marginal £1 million of collateral

(1) The Libor and repo rates, at a particular maturity, capture the interest rates charged on unsecured and secured inter-bank loans, respectively, at that maturity. For more details on the calculations see <http://www.bba.org.uk/bba/jsp/polopoly.jsp?d=141>

(2) The opportunity cost for eligible euro-denominated securities obtained through the reverse-repo channel should be the Euribor/euro repo rate (eg Eurepo) spread.

(3) Although we focus on the overnight Libor/repo rate spread, banks can obtain sterling-denominated collateral through the reverse-repo channel at longer maturities.

(4) The Continuous Linked Settlement (CLS) system is a system for the settlement of foreign exchange transactions. Member banks must make payments to CLS Bank by scheduled times during the day. If a bank fails to make its CLS payments by the deadlines it may incur penalties levied by CLS Bank International. For more details on CLS see <http://www.cls-group.com>.

(5) The throughput guidelines are that CHAPS Sterling members must, over a calendar month, ensure that on average 50% of its daily payments, by value, are made by 12 pm and that 75%, by value, are made by 2.30 pm.

even it only had to use the collateral once every 14 years. Even if the costs were as low as the Libor/repo rate spread (seven basis points), the bank would be willing to post the £1 million even if it were used only once a year.

In a competitive market, where customers can switch banks in the event of poor service (and not making time-sensitive payments for customers would count as poor service) and where banks face other costs from not making timely payments, a seven basis point or higher cost penalty on missed payments seems plausible. If this is the case, then banks will find it privately worthwhile to post collateral that they seldom use. If all CHAPS Sterling member banks behave in this way, and do not realise extreme collateral demands simultaneously, then the system as a whole will have more collateral available than is ever used. This additional collateral in turn provides the resilience that we observe in practice in the CHAPS Sterling system.

Determinants of collateral posting decisions

We can test what factors explain CHAPS Sterling banks' collateral posting behaviour using econometric techniques. Specifically we can look at the relationship between collateral posted, demand factors and the cost of posting collateral. Summary statistics on these variables are in Table 1.

Table 1
Summary statistics

	Mean	Interquartile range
Collateral posted at 7 am (£ billions)	2.48	0.54 – 3.71
Mean maximum collateral used (£ billions)	1.86	0.26 – 2.88
Variance of the maximum collateral used	0.72	0.05 – 1.10
Libor/repo spread (basis points)	7	3 – 9

The sample period covers 1 July 2003 to 30 July 2004. We measure the collateral each member bank could reasonably expect to need by supposing that this is related to a bank's mean maximum collateral used and the variance of its

maximum collateral used. These factors might be thought to capture, respectively, member banks' average transaction demand for collateral and their precautionary demand for collateral. We expect collateral posted to be positively related to both of these variables.¹ We use a 30-day window to estimate the value of the collateral a bank can reasonably expect ever to use because the bank's payment business may change over time.²

We use one measure of the cost of posting collateral, the overnight Libor/repo rate spread.³ However, in practice, this cost could apply to CHAPS Sterling member banks to varying degrees because of differences in the regulatory requirements to which banks are subject. In particular, UK retail banks are subject to liquidity requirements set by the Financial Services Authority. These requirements – the Sterling Stock Liquidity Regime (SLR) – require the relevant banks (SLR banks) to hold liquid assets on their balance sheets to cover possible liquidity demands.⁴ The set of assets a bank may hold to meet the SLR requirements largely overlaps with the set of assets the Bank of England accepts as eligible collateral for CHAPS Sterling. Moreover, the value of the assets SLR banks hold to comply with these regulations exceeds the value of collateral they post in CHAPS Sterling. Since the SLR requirements apply only at the end of the day, SLR banks can use these SLR assets as CHAPS Sterling collateral during the day, but they cannot repo these assets to obtain cash to lend overnight on the interbank market. Hence, for SLR banks, the opportunity cost of posting collateral in CHAPS Sterling may be less than the Libor/repo rate spread. Banks in the United Kingdom that are not subject to the SLR are subject to the Maturity Mismatch (MM) Regime instead.⁵ The liquidity requirement under the MM Regime is based upon net outflows over short future time horizons. A mismatch occurs if contracted outflows exceed contracted inflows within a specified time band (eg day T to day T+8). If a bank's outflows and inflows balance, liquidity regulations will not require it to hold assets

(1) This is a very simple way of modelling how banks form expectations about how much collateral they need and we do not claim that it precisely reflects how banks do form their expectations. Banks could process the information provided by past payments flows in a much more sophisticated way than the model suggests and also base expectations on information that we cannot observe, such as payment requests that they know that they will receive over the day.

(2) The mean and variance of the maximum collateral used on day t is calculated over the 30 previous days in the sample.

(3) We lag the Libor/repo rate spread by one day because we are examining the levels of collateral posted at the beginning of the day.

(4) The CHAPS Sterling member banks that are subject to the SLR regime are Barclays, Clydesdale, Co-operative Bank, HBOS, HSBC Bank, Lloyds TSB, Royal Bank of Scotland/Nat West and Standard Chartered.

(5) The CHAPS Sterling member banks that are subject to the MM regime are ABN-Amro, Citibank and Deutsche Bank.

that it could also use as collateral in CHAPS Sterling. For MM banks the Libor/repo spread could be much closer to their true cost of posting sterling-denominated collateral.

We would expect collateral posting behaviour to vary between member banks. So we control for bank specific factors by estimating collateral posting behaviour with a panel estimator, which allows for bank-specific fixed effects. The regression results are shown in Table 2.

Table 2
A fixed effects panel regression of collateral posted at 7 am: all banks

	Coefficient	t-statistic
Mean maximum collateral used	0.47	12.61
Variance of the maximum collateral used	0.30	7.65
Libor/repo spread (basis points)	-0.0127	-4.21

R² = 0.84

The demand-side measures of collateral use have the correct sign and are all highly significant in both a statistical and an economic sense. To illustrate: increasing mean maximum collateral used from its 25th percentile value of £0.26 billion to its 75th percentile value of £2.88 billion leads to a £1.23 billion rise in collateral posted at 7 am. Increasing the variance of the maximum collateral

used from its 25th percentile value to its 75th percentile value leads to a £0.32 billion increase in collateral posted at 7 am. The transactions and precautionary demand for collateral therefore appear to be important determinants of collateral posting behaviour.

The opportunity cost of posting collateral (measured by the Libor/repo spread) variable also has the economically correct sign (as the opportunity cost of posting collateral increases) and is statistically significant. However, this effect is economically small. Increasing the spread from its 25th percentile value to its 75th percentile value leads to a fall in collateral posted at 7 am of only £0.07 billion.

Conclusions

CHAPS Sterling could continue to function even in the face of an operational event that temporarily prevented a single member bank from making payments. This robustness occurs largely because member banks post more collateral than they normally need to support their payment activities. This puzzling behaviour can be explained if the reputation cost to a bank of failing to provide time-sensitive payment services to customers is high relative to the cost of posting collateral. Empirical evidence supports this explanation. This liquidity cushion in turn provides CHAPS Sterling with its resilience.

References

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