D LIQUIDITY RISK PREMIA IN MONEY MARKET SPREADS

Unsecured interbank money market rates such as the EURIBOR increased strongly with the start of the financial market turbulences in August 2007. There is clear evidence that these rates reached levels that cannot be explained solely by higher credit risk premia charged by lenders in interbank transactions. This special feature presents this evidence and provides an explanation which draws on the funding liquidity risk of lenders in unsecured money markets.

INTRODUCTION

The start of the financial market turbulence in August 2007 was marked by a strong increase in interest rates on unsecured interbank loans with maturities beyond one day (term loans). Within a few days, for example, the spread between the 12-month EURIBOR and the 12-month EUREPO rose from about 10 basis points to over 60 basis points and has remained at elevated levels since then.[1] The three-month and six-month EURIBOR followed a similar pattern (see Chart D.1).[2]

A straightforward explanation of these wider spreads draws on the notion of higher credit risk premia. The credit risk premium is the component of an interest rate that the lender demands as compensation for the risk that the borrower may default. Indeed, the perceived risk of default of the borrower in an interbank loan transaction, measured by spreads of credit default swaps (CDSs), also increased with the start of the turbulence.

However, there is clear evidence that higher credit risk premia alone cannot explain the current interbank money market spreads. If such spreads mainly reflected the credit risk of lenders, approximate no-arbitrage conditions would require that they be close to the spreads on bank CDS spreads. But, since August 2007, money market spreads have been much wider.

This special feature summarises the empirical evidence for the existence of a liquidity risk premium in current money market spreads and suggests that funding liquidity risk is the main driver of this premium.[3] Moreover, it indicates that the liquidity risk premium can be interpreted as an indicator of two important aspects of financial stability issues which are difficult to measure by other means: the risk of significant liquidity shocks; and the non-availability of assets that can be used as collateral to raise funds in repo markets.

Chart D.1 EURIBOR-EUREPO spreads

Sources: Bloomberg and EUREPO.

DECOMPOSING MONEY MARKET SPREADS

In order to decompose money market spreads into a credit risk premium and a residual component, which may be called the funding liquidity risk premium, money market spreads are compared with CDS

1 The EURIBOR is defined as the rate at which euro interbank term deposits within the euro area are offered by one prime bank to another prime bank. The EURIBOR is calculated as an average of rates reported daily by a set of major banks. The EUREPO is defined as the rate at which one prime bank offers funds in euro to another prime bank if, in exchange, the former receives from the latter general collateral from a basket of (high quality) assets.

2 EURIBOR spreads are measured throughout this special feature as spreads over repo rates. Alternatively, EONIA swap rates could be used as a benchmark. However, the results would be broadly the same.

3 The analysis is based on J. Eisenschmidt and J. Tapking, "Liquidity risk premia in unsecured interbank money markets", *ECB Working Paper*, forthcoming.

spreads. There are various ways to do this. The methodology followed here is based on arbitrage considerations.[4]

A single-name CDS contract between two parties – a protection buyer and a protection seller – is essentially a form of insurance against a default of the issuer (the "reference entity") of a bond (the "reference obligation"). It is characterised by a notional amount q, the CDS spread ρ and a maturity. The protection buyer pays a quarterly premium $(1/4)\rho q$ to the protection seller until the CDS contract matures or the reference entity defaults on the reference obligation, whichever occurs earlier.[5] The protection seller pays the notional value of the contract less the market value of the reference obligation (with a nominal value q) if default occurs before the CDS matures.

It is well-established that, in the absence of liquidity problems, the CDS spread should be approximately equal to the difference between (i) the yield of a par bond issued by the reference entity that matures when the CDS matures and (ii) the risk-free rate, e.g. the repo rate.[6] If this is not the case, then arbitrage opportunities may arise. Profits can be realised, for example, if the bond spread exceeds the CDS spread. In such circumstances, investors would raise funds at the repo rate (provided that they have sufficient collateral), buy the par bond with these funds and buy protection by means of a CDS. Investors with a cash surplus would buy the bond and protection by means of a CDS, rather than invest the surplus at the risk-free rate.

Similarly, investors could make arbitrage profits if the spread between the interest rate on a one-year unsecured interbank loan to bank *B* over the one-year repo rate were to exceed the spread of a CDS on bank *B* (the reference entity). Banks realise profits if they raise funds at the repo rate, lend unsecured funds to bank *B* and buy protection by means of a CDS on bank *B*. Banks with a surplus would lend unsecured funds to bank *B* and buy protection rather than invest the surplus at the risk-free rate.[7]

This argument establishes a relationship between the spread of a one-year CDS on bank *B* and the spread of the interest rate at which bank *B* borrows unsecured funds for one year in the interbank market. However, information on bank-specific interbank rates is not available, so that the one-year EURIBOR is used for the present analysis. The one-year EURIBOR can be considered to be a lower bound to any bank-specific interbank rate. To understand why, it is important to know how the EURIBOR is defined.

The EURIBOR is calculated as the average of 43 rates, each reported by one of the EURIBOR panel banks. The panel banks report rates "to the best of their knowledge … rates being defined as the rates at which euro interbank term deposits are being offered within the EMU zone by one prime bank to another … ('the best price between the best banks')."[8] Thus, panel banks report rates at which they believe one of the best banks offers unsecured loans with the maturity in question to another of the best banks.

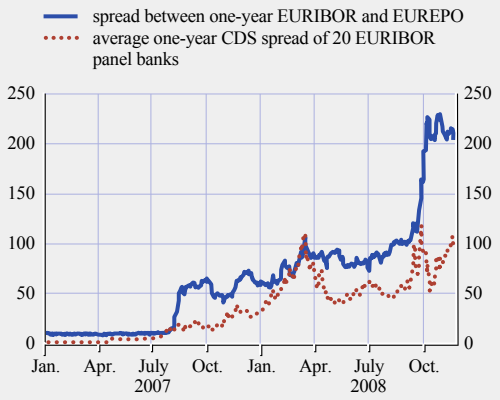
Assuming that "prime banks" are the "best banks" in the sense that they are offered relatively low rates when they borrow unsecured funds, the EURIBOR could be considered to be a lower bound. A specific bank would not normally be offered loans at rates significantly below the EURIBOR. Arbitrage opportunities should thus arise in the absence of liquidity problems if the one-year CDS spread on a given bank were below the spread of the one-year EURIBOR over the one-year repo rate.

Chart D.2 shows the spread of the one-year EURIBOR over the one-year EUREPO and the average spread of one-year CDS contracts on

4 See Box 10 in ECB, *Financial Stability Review*, June 2008 for an approach that is based on regression techniques.
5 It also applies if any other "credit event" as specified in the CDS contract occurs.
6 See for example D. Duffie, "Credit Swap Valuation", *Financial Analysts Journal*, January/February 1999.
7 The arbitrage argument is based on a number of assumptions: for example, that the recovery rate of default is the same for bonds of, and interbank loans to, the reference entity.
8 Quoted from the EURIBOR Code of Conduct, see www.euribor.org.

Chart D.2 EURIBOR spreads versus spreads of CDSs on EURIBOR panel banks

(basis points)



Sources: Bloomberg and EUREPO.

20 EURIBOR panel banks. Before the start of the turmoil, the difference between these two spreads was less than 8 basis points. However, right at the very beginning of the turmoil, this difference rose to more than 40 basis points. It remained high, except at the peak of the Bear Stearns crisis in March 2008. Based on the above argument, it could thus be concluded that the high EURIBOR spreads seem to offer arbitrage opportunities.[9]

It is notable that the EONIA, i.e. the average rate on unsecured overnight euro deposits, has not increased relative to the ECB minimum bid rate (see Chart D.3).

Chart D.3 Spread of the EONIA over the ECB minimum bid rate

(basis points)

Source: ECB.

In contrast to term money market spreads, this EONIA spread even decreased slightly (from about 6 basis points to less than 1 basis point), on average at the start of the turbulences, although it subsequently became more volatile.

TOWARDS AN EXPLANATION OF ELEVATED EURIBOR SPREADS

Why do EURIBOR spreads persist at levels that seem to offer arbitrage opportunities? One possible explanation draws on the funding liquidity risk borne by the lender in an unsecured interbank transaction.

Consider a bank with a liquidity surplus. It could offer one-year unsecured loans in the interbank market. However, it could be hit by a liquidity shock (outflow of liquidity) before such loans mature. The resulting liquidity deficit would force the bank to raise funds. This may be costly or even difficult.

If the bank considers the probability of a significant liquidity shock within one year to be negligible, it might be willing to lend unsecured funds for one year at a rate that compensates only for the risk that the borrower may default. This rate would equal the risk-free one-year rate plus a spread close to that of a one-year CDS on the borrowing bank.

The same may be true (at least in the absence of interest rate risks) if the bank assumes, on the one hand, that a liquidity shock is likely, but believes, on the other hand, that it would be able to borrow funds at a rate close to the risk-free rate if a liquidity shock were to materialise. It would be able to do so if other banks perceive its probability of default as being very low, or if the bank expects to have sufficient high-quality collateral to enable it to borrow in the repo market.

9 It is assumed here that there is no counterparty risk in CDS contracts, so that CDS spreads only reflect the probability of a credit event (and the recovery rate of default of the reference entity). Indeed, as CDS contracts are typically collateralised, the risk that the protection seller may default on its obligations appears to be low.

However, the situation changes if three conditions, which together define the bank's funding liquidity risk, are fulfilled:

- The probability of a significant liquidity shock within one year is not negligible.
- The default probability of the bank at the time of such a liquidity shock is not negligible.
- The probability of a shortage of high quality collateral available to the bank at the time of a liquidity shock is not negligible.

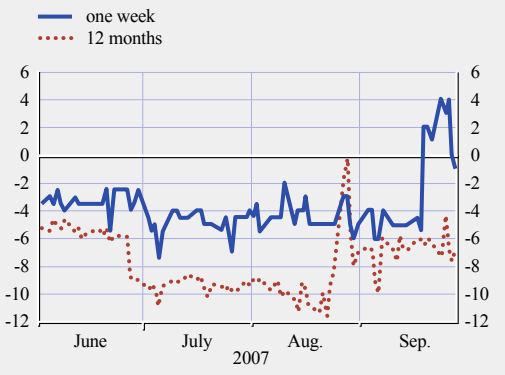
If these conditions are fulfilled, then the bank must take into account the possibility that it may need to refinance any one-year loan granted in the unsecured interbank market at a high cost. As a result, the bank will only be prepared to lend unsecured funds for one year at a rate that also compensates for its funding liquidity risk. It should be noted that, due to the funding liquidity risk, the bank cannot engage in arbitrage even if it could lend unsecured funds at spreads above those of CDS contracts on borrowing banks.

As an alternative to granting a one-year loan, the bank could repeatedly offer overnight unsecured loans in the interbank market. Every day, the bank's money would be repaid to it (plus interest) and it could offer a new overnight loan. If the bank were hit by a liquidity shock, it would use the repayment S of the loan granted on the previous day to offset its liquidity deficit D. If S were smaller than D, it would need to raise only D-S and would not offer a new loan. Thus, funding liquidity risk no longer plays a significant role, so that the bank can offer overnight loans at rates that do not include a liquidity risk premium.[10]

This suggests that banks with a cash surplus will, in times of funding liquidity problems, offer unsecured term loans at elevated rates, while overnight loans may be offered at relatively low rates. This is consistent with the evidence provided in the previous section.[11]

Chart D.4 Spread of EUREPO rates over EONIA swap rates

(basis points)



Source: ECB.

It should be noted that this reasoning applies only to the unsecured interbank market, and not to repo markets. If a bank grants a general collateral repo loan for a longer term, then, for the life of the loan, it receives in exchange assets eligible to be used as collateral in repo markets. It can reuse this collateral to raise funds itself in the repo market at the low repo rate if it is hit by a liquidity shock before the loan matures. Funding liquidity risk may therefore play a subordinate role in general collateral repo markets. This is in line with the observation that the difference between short-term and long-term repo spreads against overnight index swaps (which was small before the turmoil) did not increase at the start of the turbulences (see Chart D.4).

FINANCIAL STABILITY CONSIDERATIONS

While probabilities of default can be measured directly by means of CDS spreads, it is very difficult to measure directly (i) the probability (and magnitude) of future liquidity shocks and

10 Funding liquidity risk in overnight transactions may still play a minor role since such transactions may be concluded in the morning, so that the lender faces the risk of a liquidity shock in the afternoon.

11 Another major reason for low EONIA levels (in addition to the low funding liquidity risk in overnight transactions) is doubtless the liquidity policy of the Eurosystem that aims to keep the EONIA close to the Eurosystem's main refinancing rate.

(ii) the expected availability of high-quality collateral. The analysis presented here suggests that the difference between unsecured money market spreads and CDS spreads may be used as an indicator to this end. Given the significance of liquidity shocks and collateral for financial stability, this indicator is important for financial stability analysis.

At the present juncture, the analysis suggests that the probability that individual banks – including banks that currently have a liquidity surplus – will be hit by significant future liquidity shocks and, at the same time, face a shortage of high-quality collateral has reached exceptionally high levels (see the difference between the EURIBOR-EUREPO spread and the CDS spread as shown in Chart D.2).

This view is also supported by a number of other observations.

First, banks with an exposure to certain types of special purpose entities, such as special investment vehicles (SIVs) have, since the start of the turmoil, faced a higher risk of having to support such entities. An SIV is typically set up by a bank for the purpose of raising short-term funds and investing them, in particular, in longer-term asset-backed securities (ABSs). Since the start of the US sub-prime crisis, investors have feared that ABSs could underperform and they are therefore more reluctant to renew short-term loans to SIVs. As a consequence, the risk that a bank will need to support an SIV – i.e. provide liquidity to the SIV in exchange for ABSs – has increased. As ABSs are not normally accepted as collateral in repo markets, financially supporting an SIV could imply a significant liquidity shock and a simultaneous deterioration of the quality of available collateral.

Second, fewer asset types are reportedly being accepted as collateral in repo markets than was the case prior to the turmoil. This applies, in particular, to structured assets such as ABSs.

Third, since the start of the turmoil, Eurosystem counterparties have, on average, used as collateral in operations with the Eurosystem far fewer assets than are accepted in repo markets. This indicates that counterparties reserve these assets for repo transactions.[12]

Finally, there is also some evidence that counterparties who mainly use ABSs as collateral in operations with the Eurosystem submit on average higher bid rates at Eurosystem refinancing operations than those who mainly use assets that are also accepted in repo markets. These bid rates have reached levels far above repo rates. One possible explanation is that many banks that mainly use ABSs in operations with the Eurosystem expect to or have already run short of collateral accepted in repo markets. If they are unable to raise funds in Eurosystem operations, they will need to borrow unsecured funds at even higher rates.

It is important to note in this context that there is no risk of an aggregate liquidity shortage, since it is the policy of the Eurosystem to ensure that the banking sector has enough liquidity in aggregate terms. Nor are there any indications that the banking sector has, on aggregate, a shortage of collateral accepted in repo markets. This may be due in no small measure to the collateral policy of the Eurosystem, since it accepts a wide range of assets as collateral. Therefore, the Eurosystem has not absorbed assets that could otherwise have been used in repo markets.

CONCLUDING REMARKS

Spreads of unsecured interbank term money market rates have revealed significant liquidity risk premia. It can be argued that these premia reflect the funding liquidity risk of lenders in interbank transactions. The funding liquidity risk in this context is (i) the risk that the lender

12 These assets are mainly central government bonds. Besides these bonds, the Eurosystem accepts several other asset types as collateral, such as corporate bonds, covered and uncovered bank bonds, ABSs and certain non-marketable assets. For a discussion of the use of assets in repo markets and in central bank operations, see C. Ewerhart and J. Tapking, "Repo markets, counterparty risk and the 2007/2008 liquidity crisis", *ECB Working Paper,* No 909, June 2008.

will be hit by a liquidity shock before the loan matures; (ii) the lender will only be able to raise funds at the time of the shock at relatively high rates because of a lack of high-quality collateral (so that funds cannot be raised in the repo market); and (iii) market perceptions that there is a non-negligible probability that the lender will default.

Against this background, the liquidity risk premium in interbank money market rates can be interpreted as an indicator of the risk that individual banks with a lack of high-quality collateral will be hit by a significant liquidity shock.