

Developments in repo markets during the financial turmoil¹

As the financial crisis deepened and unsecured interbank markets effectively shut down, repo market activity became increasingly concentrated in the very shortest maturities and against the highest-quality collateral. Repo rates for US Treasury collateral fell relative to overnight index swap rates, while comparable sovereign repo rates in the euro area and the United Kingdom rose. The different dynamics across markets reflected, among other things, differences in the intensity of market disruptions and the extent of the scarcity of sovereign collateral.

JEL classification: E43, E58, G12.

Repo markets are a vital source of secured financing for banks and financial institutions, and a key tool for the implementation of monetary policy. A repo, or sale and repurchase agreement, is a sale of a security coupled with an agreement to repurchase the same security at a specified price at the end of the contract.² Repo markets have doubled in size since 2002, with gross amounts outstanding at year-end 2007 of roughly \$10 trillion in each of the US and euro repo markets, and another \$1 trillion in the UK repo market. This article reviews recent developments in this critical component of the global financial system, with particular focus on the period since the start of the financial turmoil in mid-2007.

Despite the presence of collateral, repo markets were quickly affected by the turmoil. Concerns about the creditworthiness of counterparties and the ability to realise the value of the collateral in a sale meant that repo transactions were increasingly restricted to short maturities and against only the highest-quality securities. As financing in unsecured markets became more

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² A repo seen from the point of view of the cash lender is called a reverse repo. The difference between the sale price and the repurchase price is the interest rate, known as the repo rate.

expensive or unavailable, financial institutions with funding requirements bid more aggressively in repo markets to secure financing.³ Meanwhile, traditional repo investors that lend cash pulled back from the market, reducing the quantity of financing available. At the same time, the flight to government securities and the hoarding of US Treasuries by investors led to a general scarcity of top-quality collateral, with repo rates for US Treasury securities falling to levels close to zero. Overall, the US repo market experienced significantly more disruptions than either the euro area or the UK repo market.

This article proceeds as follows. The first section describes key features of the US, euro area and UK repo markets. The second section discusses various risks in repo transactions. The third section briefly describes conditions in repo markets as the crisis progressed, while the fourth highlights key differences in US and European repo markets during the crisis. The fifth section describes central bank actions relevant for repo markets and their impact on market dynamics. The final section discusses some longer-term implications from the crisis.

Key features of the US, euro area and UK repo markets

Conceptually, a repo can be viewed as a form of collateralised loan, where a security lender posts a security as collateral with a cash provider. A typical repo therefore leads to an outflow of collateral and an inflow of cash, while a reverse repo leads to an inflow of collateral and an outflow of cash.⁴ Repos are either cash-driven or securities-driven. A cash-driven repo is motivated by the desire to raise short-term funding, from overnight up to one year in maturity. When a repo is driven by the desire to borrow a specific security, the repo is known as a “special”.

Repos can be seen as a form of collateralised loan

Bond repo markets developed at different points in time in the G10 countries – in the 1920s in the United States, the 1970s in continental Europe and the 1990s in the United Kingdom. In most cases, their use was promoted by monetary authorities, which used them as a monetary policy tool and a means to increase the depth, liquidity and price efficiency of markets (BIS (1999)). Repo markets are used actively by a variety of actors. Banks and dealers use repos to finance inventories, to cover short positions, to create leverage and to hedge or speculate on interest rate movements. Investors such as mutual funds, pension funds, insurance companies and corporate treasurers use repo markets to invest surplus cash, to earn incremental returns on their portfolios or to raise cash for investment.

Like other over-the-counter markets, repo markets are large but relatively opaque. In the United States, regulatory reports provide an indication of gross amounts outstanding, but little to no data are available on maturities,

Repo markets are large but opaque

³ Financial institutions also turned to foreign markets to raise unsecured funds via foreign exchange swaps and cross-currency swaps (Baba et al (2008)).

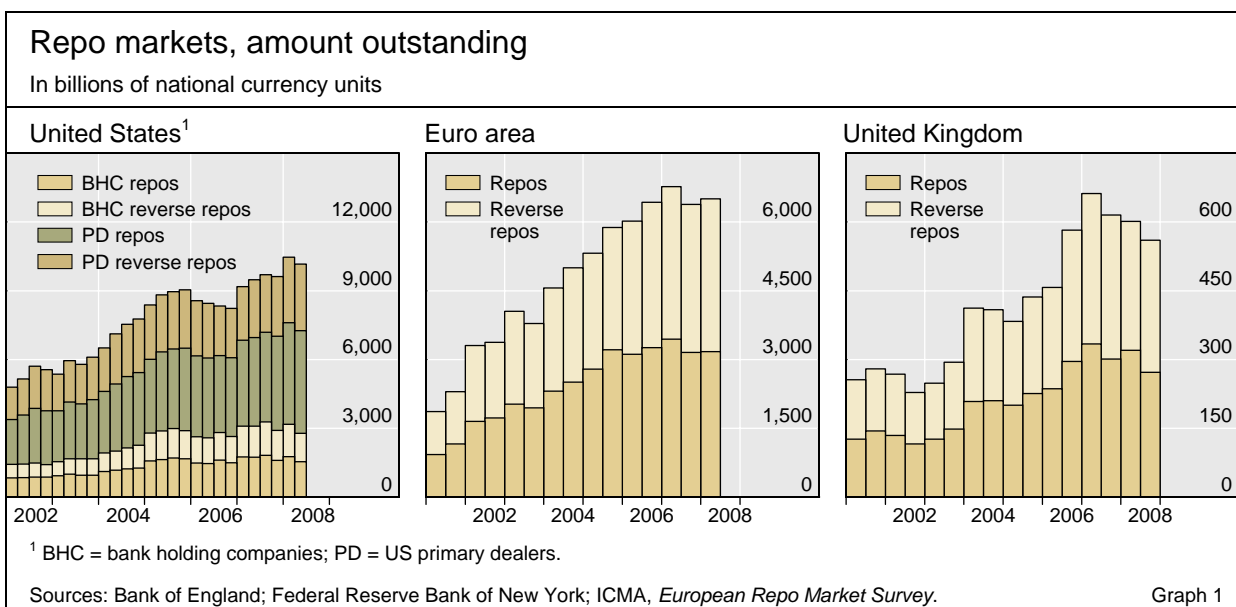
⁴ Central banks, by contrast, view such transactions from the point of view of their bank/dealer counterparties, with repos temporarily adding reserve balances to the banking system while reverse repos temporarily drain balances from the system.

Repo markets have grown rapidly in the United States ...

composition of collateral or turnover. Data reported by 19 primary dealers⁵ and around 1,000 bank holding companies suggest that by mid-2008 the gross market capitalisation of the US repo market exceeded \$10 trillion (including double-counting of repos and reverse repos), corresponding to around 70% of US GDP (Graph 1).⁶ The primary dealers are the most active participants, and use repos to finance much of the growth of their balance sheets, creating procyclical leverage and an exposure to refinancing risk (Adrian and Shin (2008)). In particular, the (former) top US investment banks funded roughly half of their assets using repo markets, with additional exposure due to off-balance sheet financing of their customers. While the US repo market is dominated by trading in US Treasuries, there are also active markets in bonds issued by US government-sponsored agencies (agencies), agency mortgage-backed securities (MBS) and corporate bonds. Market participants suggest that, prior to the crisis, non-government collateral contributed significantly to the rapid growth of the US repo market.

... and in the euro area as well

A more complete picture is available for the euro area repo market based on data collected by the ECB and the European Repo Council. The euro area repo market has also grown sharply, more than doubling in size over the past six years to reach €6 trillion outstanding (or around 65% of euro area GDP). Two thirds of the collateral is central government bonds from euro area countries, 16% from other euro area entities and 12% from other OECD countries. In terms of country of issuance, German collateral makes up one quarter of the market, followed by Italian at 13%, French at 11% and other euro area at 15%. Whereas there are more than 7,500 banking participants, activity



⁵ Primary dealers are banks and broker-dealers that may trade in US government securities directly with the Federal Reserve Bank of New York.

⁶ This market capitalisation amount (as well as those mentioned for the euro area and the United Kingdom below) includes a large degree of double-counting, as repos between reporting institutions are included in the totals for repos and for reverse repos. As a result, the figures are likely to overstate the true repo volumes by roughly a factor of two.

is highly concentrated, with the top 20 banks accounting for 80% of activity. Two thirds of repos have a maturity of one month or shorter, with the rest up to one year. Around half of euro repos are transacted directly between counterparties, while the remainder are brokered using either voice brokers or an electronic trading platform.

The Bank of England collects data from around 60 banks and securities dealers on the UK repo market. Although substantially smaller than the US and euro markets, the gilt repo market has also seen strong growth rates in recent years, with total repos and reverse repos outstanding doubling since 2003 to reach a peak of £662 billion (or around 50% of UK GDP) in mid-2007. This market has since declined, falling to £560 billion by August 2008. Turnover in this market has increased at a similar pace, reaching £3.5 trillion in mid-2007. Whereas the amounts outstanding are split evenly between maturities of one month and shorter and longer than one month, turnover is heavily concentrated in short maturities, with two thirds in the overnight segment and only 5% in maturities longer than one month. Banks account for three quarters of transactions, while securities houses, building societies, fund managers and insurance companies account for the remainder. Market contacts suggest that four to six banks dominate activity.

Turnover is heavily concentrated in short maturities

Risks in repo transactions

Like other financial markets, repo markets are subject to counterparty credit risk, market risk and operational risk. These risks are minimised but not eliminated through a variety of risk management tools, including the use of collateral and initial margins, daily marking to market of collateral, position limits with counterparties, and concentration limits for specific securities. Counterparty credit risk, or the risk that one party to a transaction will default, is addressed by posting securities as collateral. Under most circumstances, the collateral is legally the property of the cash provider, who can sell it in the event that the security lender defaults on the loan.⁷ The nature of the collateral is important. A repo against a basket of non-specific government securities, known as a general collateral (GC) repo, is associated with the lowest level of risk. The interest rate on an overnight GC repo is therefore typically close to the overnight policy rate.

Repos feature several risks ...

The main risk in a repo transaction is market risk. Market risk arises from price volatility as well as the ease with which the value of the collateral can be realised in a sale. A decline in the price of securities serving as collateral can result in undercollateralisation of the repo. To address these risks, repos feature initial margin (or a “haircut”) where the quantity of cash (or securities) delivered is adjusted to ensure overcollateralisation, typically in favour of the cash provider. The collateral is marked to market every morning and the

... principally market risk ...

⁷ The legal status of the parties to a repo transaction depends on a number of factors, including the form of the contract, the law governing the arrangement, and the specific terms of the contract. Repos are typically structured as a “true sale” and are often documented using the global master repurchase agreement (GMRA).

margin updated based on the closing price from the night before. The size of the haircut reflects the market risk of the collateral, with longer-maturity bonds and lower-rated securities requiring higher margin due to their higher price volatility.⁸

... and operational risks

Repo markets feature operational risks related to the transfer and management of the collateral. Settlement is typically delivery versus payment (DVP), where cash is delivered against receipt of the collateral. Either party to a repo may fail to deliver. A “fail” to deliver a security is a situation in which a trade involving a security does not settle on schedule. Such a fail is not treated as a contractual default in the repo market (Fleming and Garbade (2005)). Instead, the failing security provider can make delivery the next day at the unchanged invoice price. The security provider is exposed to movements in the price of the securities, and loses the interest they could have earned by investing the cash overnight.

Another operational risk relates to who holds the collateral. There are three types of repo, each with different benefits and costs that are reflected in the repo rate and the haircut: bilateral repo, triparty repo and hold-in-custody repo. In a bilateral repo, the collateral is held on the balance sheet of the cash provider, granting immediate access in the event of default on the loan. In a triparty repo, an agent stands between the security lender and cash provider and physically controls the securities offered as collateral. The original counterparties remain as principals to the transaction, but the agent – typically a custodial bank – manages the collateral, making substitutions when necessary, monitoring risk and collecting payments. Legal title to the collateral remains with the cash provider in case of default.⁹ In a hold-in-custody repo, the security lender continues to hold the bond on their own balance sheet in a segregated account, raising the risk to the cash provider.

Risks affect repo rates ...

The risks mentioned are reflected in the interest rate at which a repo transaction is agreed. Repo transactions involving riskier types of collateral typically offer higher repo rates than for GC collateral. There are other factors that can significantly affect repo rates. In the special repo market, high demand for a particular security can exert substantial downward pressure on repo rates for transactions involving that security, as it becomes increasingly scarce. In other words, cash providers will accept a lower return on their cash in cases where they need to borrow a specific security, for example to be able to cover a short position. In times of severe market turbulence, surging demand for safe

... as does scarcity of collateral

⁸ Under Basel II, the standard supervisory haircut for a repo transaction is 0.5% for sovereign bonds with a residual maturity of less than one year, 2% for those with a residual maturity from one to five years, and 4% for longer-maturity issues. The comparable haircuts for non-sovereign bonds rated AA– or higher are 1%, 4% and 8%. For more complex instruments, a market rule of thumb has been to set the haircut at one minus the price, ie a security valued at 70 cents would have a haircut of 30%.

⁹ A related form of repo involves a central counterparty (CCP), which is a type of clearing house that sits in the middle of a trade and guarantees delivery. The CCP assumes the counterparty risk if one side fails to deliver, and requires adequate margin from both sides at all times. The CCP is supported by its own capital base and capital paid in by member institutions.

government securities and a general unwillingness to repo them out can result in similar downward pressure on rates for the GC repo market as a whole.

Conditions in repo markets during the crisis

This section briefly highlights developments in repo markets during the crisis, while key changes and central bank actions are examined in subsequent sections.¹⁰ To better understand how repo markets were affected by the crisis, it is useful to take a look at conditions before the outbreak of the turmoil. We focus on developments in GC repo rates relative to overnight index swap (OIS) rates, which provide a near risk-free benchmark.¹¹ Prior to mid-2007, GC repo rates were on average 5–10 basis points below comparable OIS rates in the United States, and only 1–2 basis points below them in the euro area and the United Kingdom. The lower GC repo rate is due to the presence of collateral as well as the larger market size and greater participation in repo transactions relative to OIS. Repos using lower-rated or less liquid collateral, such as US agencies or MBS, typically required somewhat higher interest rates, around 1–2 basis points below OIS rates on average.

Like OIS, repo rates reflect minimal risks ...

Mid-2007 to February 2008: the crisis unfolds

Starting in mid-2007, heightened concerns about counterparty credit risk and surging demand for liquidity led to significant disruptions in credit and money markets. Sharp swings in asset prices resulted in greater uncertainty about the value of collateral, particularly hard-to-value and less liquid collateral. As a result, repo markets quickly began to show signs of stress, although the impact on repo rates was less pronounced than for unsecured Libor rates, which widened significantly relative to OIS rates (Michaud and Upper (2008)) (Graph 2). The US repo market in particular appeared to be undergoing stress over this period, while the pricing in euro area and UK markets signalled calmer conditions. In the United States, repo rates became substantially more volatile and it became problematic to obtain funds at maturities longer than one month. Collateral profiles became more conservative and margin requirements rose. GC repo rates began to fall vis-à-vis OIS rates of comparable maturity, reflecting increased demand for safe government securities. By contrast, repo rates for riskier types of collateral rose as the appetite for holding anything but the highest-quality collateral dropped.

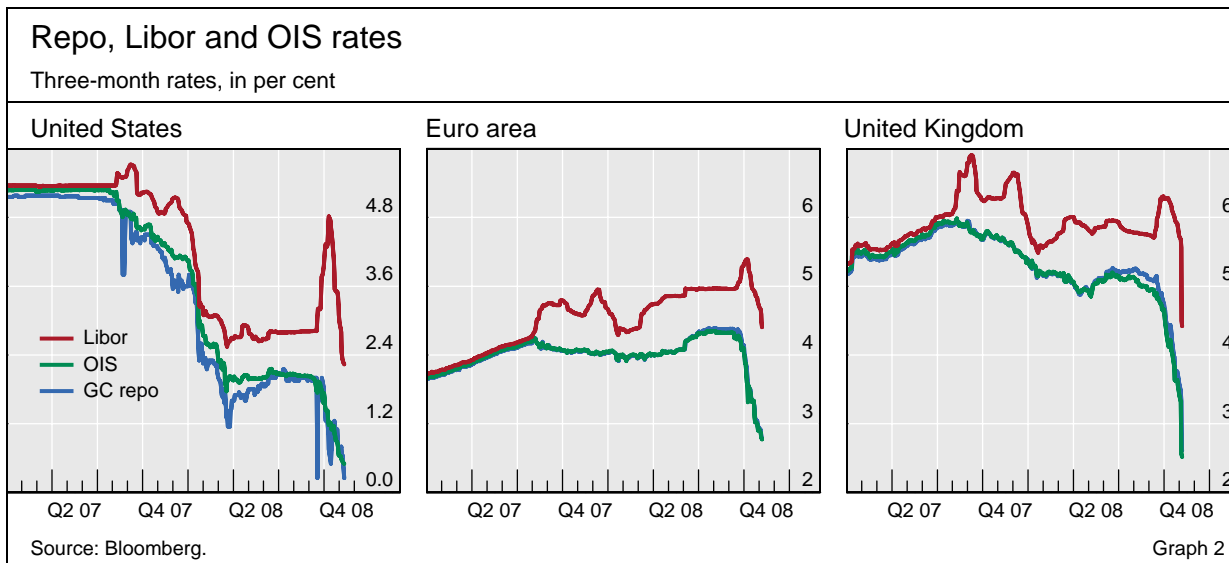
... but have been affected by the onset of the turmoil ...

... with US GC repo rates falling relative to OIS

Average repo-OIS spreads over this period paint a similar picture across a spectrum of maturities (Graph 3). US GC repo rates, which had been 5–10 basis points below OIS rates before mid-2007, shifted downwards by

¹⁰ This section has benefited from the study by Bearing Point (2008).

¹¹ In an OIS, a fixed short-term interest rate is exchanged for the average overnight interest rate during the maturity of the swap. OIS contracts provide a useful benchmark because, in contrast to unsecured interbank rates, they are considered nearly free of credit risk and have been little affected by the surge in counterparty credit risk and liquidity demand seen since the outbreak of the turmoil. This is due to the fact that OIS contracts require no payment upfront, but are settled on a net basis at maturity.



around 20 basis points during the first seven months of the financial turmoil, although there was considerable variation around this average. At the same time, available data for Europe show that GC repo rates in the euro area and the United Kingdom were very little changed during the period from June 2007 to February 2008. (The different dynamics of US and European GC repo rates and possible explanations are discussed in more detail below.) Meanwhile, repo rates for US agency securities rose to a premium of 5–10 basis points above OIS rates, indicative of the diminished demand for lower-quality collateral.

March 2008: rescue of Bear Stearns

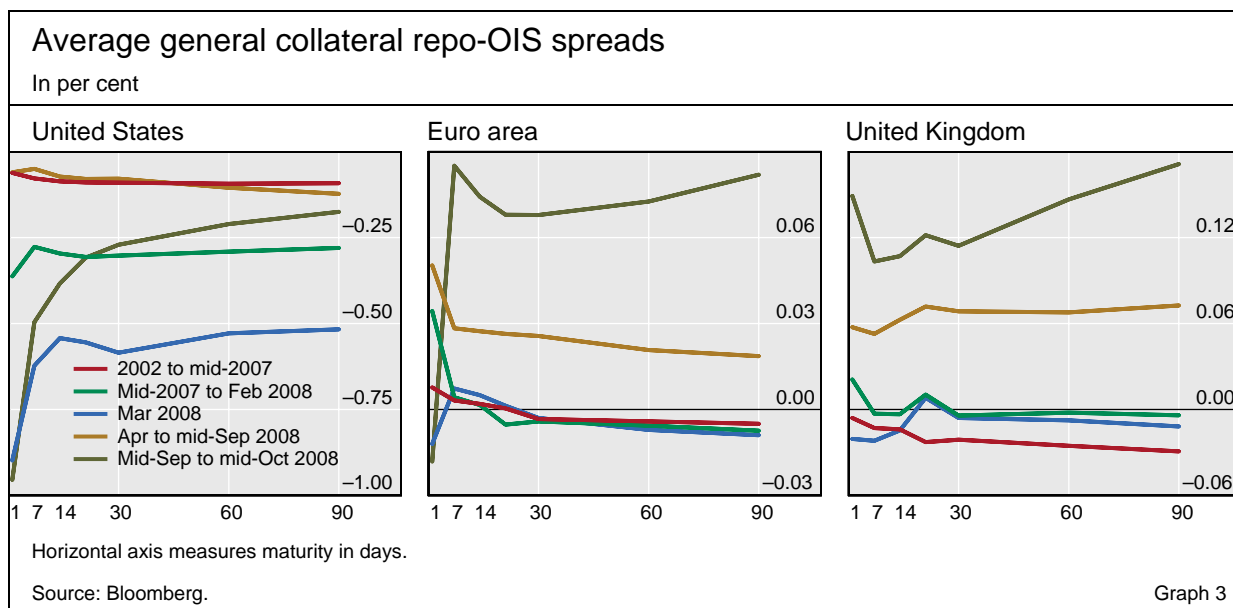
Conditions deteriorate in March ...

Market conditions deteriorated significantly in early March, as interbank and wholesale funding dried up and financial actors without access to central bank liquidity struggled. The highest-profile victim of the deteriorating market situation was the US investment bank Bear Stearns, which avoided bankruptcy in mid-March due to a rapid takeover by JPMorgan Chase, assisted by liquidity from the Federal Reserve. The US central bank also introduced a number of new facilities, including the Term Securities Lending Facility (TSLF), which lends Treasury securities against a range of eligible assets (as discussed in more detail below), and the Primary Dealer Credit Facility (PDCF), which extends discount window-type borrowing to primary dealers.

... with maturities shortening ...

As the crisis intensified, repo markets became increasingly strained, in particular in the United States. The average US GC repo-OIS curve shifted downwards by 25–30 basis points, and even more at the shortest maturities (Graph 3). Term repo markets dried up, with little activity in maturities longer than one week, suggesting that the very low repo rates seen at the short end of the curve were more indicative of actual repo market conditions than the pricing further out along the curve. Activity in repo markets became more and more concentrated in only the highest-quality collateral; repos in corporate or structured products were essentially no longer possible. Credit lines were cut and concentration limits tightened further.

... and activity concentrating in the highest-quality collateral



April to mid-September 2008: a temporary lull in the turmoil

A flurry of central bank activity contributed to a gradual improvement in financial market conditions. It also resulted in greater availability of government collateral for repo transactions, which – in combination with reduced safe haven demand for Treasury securities – helped ease the pressure in the GC repo market, in particular in the United States. GC repo rates shifted upwards from April to mid-September, with the average US GC repo-OIS curve returning to pre-crisis levels (Graph 3). On the other hand, US repo rates for collateral other than GC did not change during this period, suggesting that the willingness to accept anything less than top-quality collateral remained very limited.

In the euro area and the United Kingdom, there was a rise in GC repo rates above corresponding OIS rates during this period. This increase seemed to partly reflect increased efforts by European banks to obtain much needed funds in the secured market, as conditions in unsecured money markets remained strained.

Mid-September to mid-October 2008: Lehman collapses and the crisis intensifies

Following Lehman Brothers' bankruptcy on 15 September, conditions in financial markets deteriorated to new lows (see the Overview). Liquidity demand surged while perceived counterparty risk rose to record highs, resulting in the virtual shutdown of the unsecured interbank lending market. At the same time, flight to safe haven government securities intensified.

The combination of accelerating borrowing demand and increasingly dysfunctional markets for unsecured interbank borrowing meant that banks again increased their efforts to secure funding in repo markets. As a result, GC repo rates in Europe came under renewed upward pressure while the very short end of the US GC curve fell sharply below corresponding OIS rates as

Market conditions deteriorate following Lehman's bankruptcy ...

... with US and euro GC rates moving in opposite directions

investors piled into Treasuries and became extremely unwilling to repo them out (Graph 3).

Mid-October 2008 onwards: tensions ease as governments step in

Market tensions ease in October

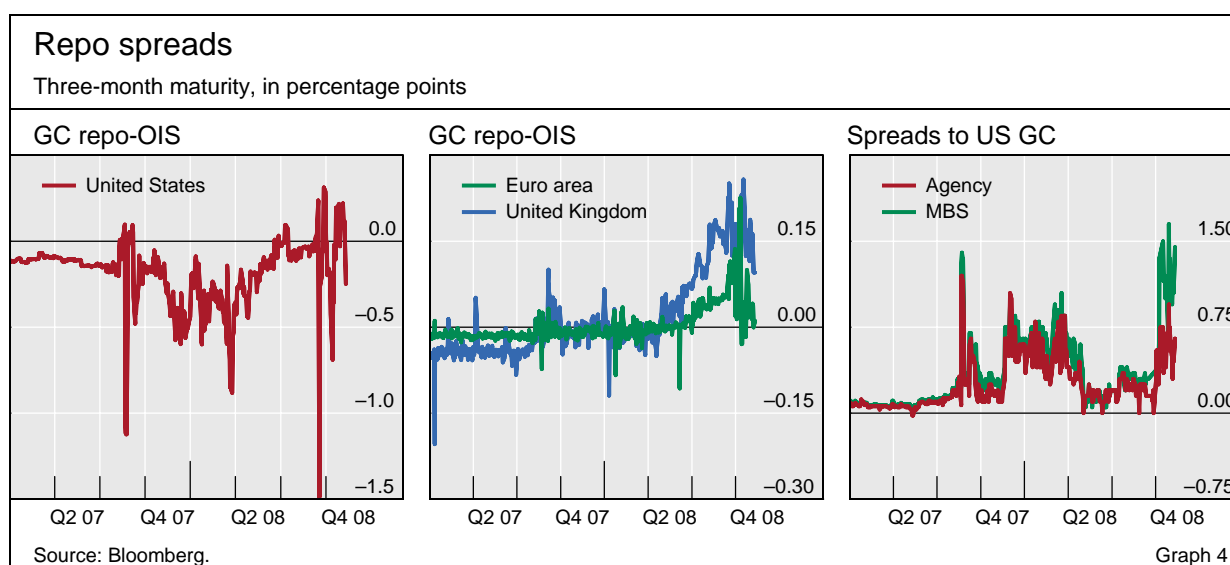
With increased liquidity provision by central banks and government intervention to recapitalise banks in the United States and Europe, strains in money markets began to ease. Repo markets also saw improving conditions, with longer terms becoming available and turnover rising. Repo rates for sovereign collateral began to normalise, and traditional cash providers slowly returned to the market.

Key differences between US and European repo markets during the crisis

A key feature during the financial crisis has been the very different patterns seen in US repo markets relative to those in Europe. As described above, spreads between GC repo and OIS rates were initially very little affected in the euro area and the United Kingdom, and subsequently moved in the opposite direction to US spreads as the crisis progressed. By September, the entire US GC repo market was trading at rates associated with special collateral, while GC repo rates in Europe had risen above OIS. This divergence is highlighted in Graph 4, which shows daily movements in GC repo-OIS spreads at the three-month term for the three markets. Another difference, also seen in Graph 4, is the substantially higher volatility of US repo spreads. The different dynamics in Europe compared to the United States may be due to a combination of factors, including: differences in the type of participants; differing central bank actions and operating procedures; the relative availability of sovereign collateral; and the way that available euro area GC rates are calculated. These factors are discussed in this section.

Particularly strained conditions in the US repo market ...

Movements in repo rates and commentary from market participants suggest that the disruptions to the US repo market were significantly more severe than in Europe. A key factor behind this seems to have been the



dominance in the US repo market of investment banks, whose business model included taking highly leveraged positions that, to a large extent, were financed in repo markets. Before the outbreak of the turmoil, the United States featured an active repo market for structured securities, such as private label MBS and collateralised debt obligations, as well as lower-rated collateral, such as high-yield bonds. As a result, investment banks with large portfolios of structured products are reported to have financed up to half their total assets in the repo market, particularly the triparty repo market.

... seem to be due to the leveraged activity of US investment banks ...

The triparty repo market facilitated the financing of these securities in three principal ways. First, it facilitated the pledging of collateral by matching cash lenders with security providers. Second, it increased participation in the US repo markets, providing a cost-effective means for non-specialist institutions that lacked the necessary infrastructure to engage in repo markets. A number of smaller players joined the US repo markets from 2006 onwards, but these marginal players quickly exited the market as the turmoil increased towards the end of 2007. Third, triparty repo reduced counterparty risk, by requiring both parties to a repo transaction to post and maintain adequate margin with the triparty agent.

By March 2008, however, the financial turmoil reached a point where heightened risk aversion coupled with uncertainty over valuations of particularly risky products led participants in the repo market to abruptly stop accepting anything other than Treasury and agency collateral. As a result, investment banks such as Bear Stearns suddenly found themselves short of funding, as a large part of their collateral pool was no longer accepted by the US repo market. This change led to a sharp increase in the demand for government securities for repo transactions, which was compounded by significantly higher safe haven demand for US Treasuries and the increased unwillingness to lend such securities in repo transactions. As the crisis unfolded, this combination resulted in US government collateral becoming extremely scarce. As the available supply of Treasury collateral dropped, those market participants willing to lend out Treasuries were able to borrow cash at increasingly cheap rates. At times, this effect pushed US GC repo rates down to levels only a few basis points above zero.¹²

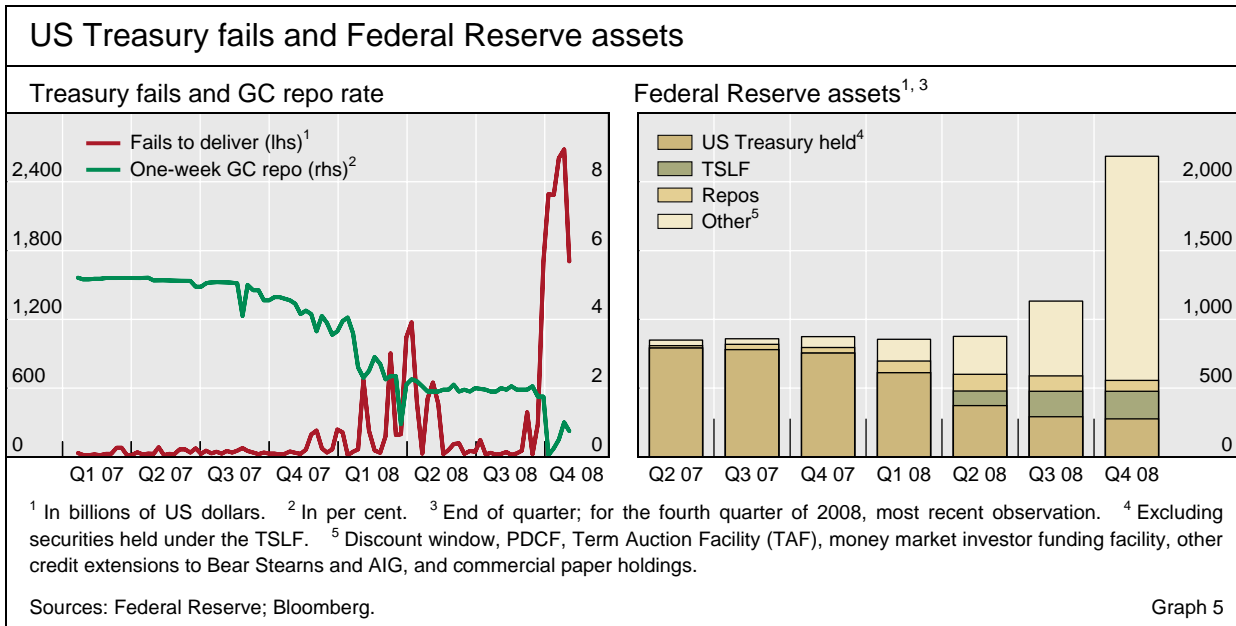
... which are suddenly able to use only GC for funding ...

... contributing to the extreme scarcity of US government securities ...

The scarcity of US Treasuries for repo transactions also manifested itself in a sharp increase in the number of Treasury settlement fails. Whereas fails to deliver Treasuries had averaged around \$90 billion per week during the two years preceding the crisis, they rose to above \$1 trillion during the Bear Stearns episode and then soared to record highs of almost \$2.7 trillion following the Lehman default (Graph 5). The extraordinarily low GC repo rates during this period exacerbated the problem by reducing the cost of failing. Normally, the failing party would borrow the necessary security through a reverse repo to avoid failing. But when repo rates are close to zero, the interest rate earned overnight is below the cost to borrow the required securities, so

... and soaring Treasury fails

¹² The low GC repo rates have not responded to the reopening of key benchmark maturities in recent Treasury auctions, the potential for greater supply in the future, or the decision to allow the Federal Reserve to pay interest on deposits.



there is no incentive to avoid failing (Fleming and Garbade (2005)).¹³ As settlement fails increased, investors who had previously lent out their Treasuries pulled back from the repo markets, as the low GC rates available were not enough to compensate for the risk that the securities might not come back. These dynamics have been recognised by the Treasury Market Practices Group, a body of market participants convened by the Federal Reserve Bank of New York, which in November proposed several measures aimed at reducing the number and persistence of fails.¹⁴

Less stressed conditions in European markets ...

In contrast to the United States, the repo markets in the euro area and the United Kingdom did not appear to undergo severe scarcity of sovereign collateral or a persistent rise in settlement fails. The broader range of participants and different collateral profile in European markets meant that the repo market's sudden refusal to accept anything but top-quality collateral had much less impact in Europe than in the United States.

... partly reflect central bank operating procedures ...

Another factor that may have prevented serious scarcity of sovereign collateral in Europe was the different operating procedures of European central banks compared to the Federal Reserve. In particular, the ECB from the outset accepted a broad range of collateral for its lending operations from a wide variety of counterparties.¹⁵ The ability to post less liquid collateral (including non-marketable loans) with the ECB may have resulted in greater availability of

¹³ As discussed in Fleming and Garbade (2005), elevated levels of fails may be costly for the market as a whole. Fails are associated with an increase in counterparty credit risk, as they expose the cash provider to a potential fall in the collateral value before the trade is settled. In addition, fails generate increased administrative and legal costs, and may worsen relations between counterparties. More importantly, persistently high levels of fails can lead to reduced market liquidity, as market participants prefer to withdraw from the market.

¹⁴ The details of the proposal can be viewed at www.newyorkfed.org/tmpg/PR081112.pdf.

¹⁵ While the Federal Reserve accepts a wide variety of collateral at its discount window, this facility is available only to depository institutions, and its usage has been limited by perceptions of stigma.

government securities for repo transactions among banks in the euro area relative to the United States.¹⁶

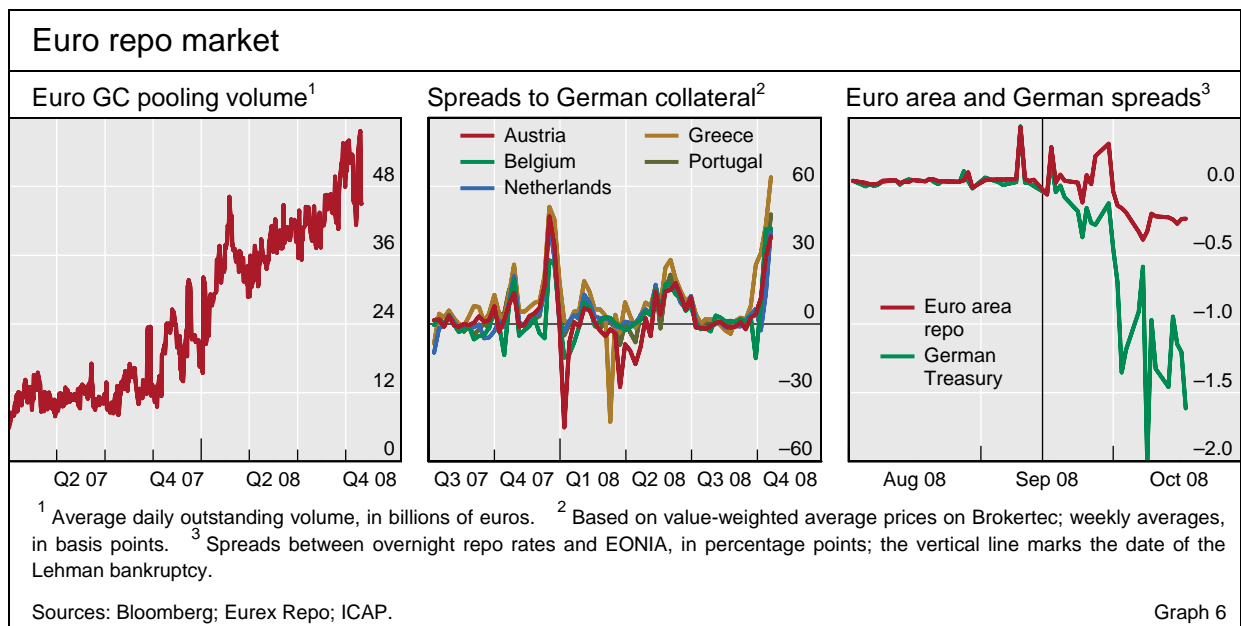
In addition, market initiatives such as Euro GC Pooling have contributed to mobilising GC collateral in the euro area, generating sharp growth rates as the crisis progressed. This system enables repo transactions via a CCP and offers an automated cross-border collateral management system that allows reuse of GC collateral and pledging of collateral with the ECB. While the outstanding volume in Euro GC Pooling had fluctuated around €10–15 billion prior to mid-2007, it thereafter rose quickly to reach €50 billion by September 2008 (Graph 6).

The apparent greater availability of GC in Europe compared to the United States meant that there was little downward pressure on European GC repo rates. Instead, upward pressures dominated. As the crisis progressed, cash providers seemed to require higher repo rates in order to be induced to lend. This tendency for higher premia in repo rates is likely to have reflected not only heightened risk aversion and greater preference for cash, but also great uncertainty among cash providers with respect to the collateral value that they would be able to realise in the event of default by the security lender, given increased price volatility. While such forces may have been at play in US markets, they appeared to be completely dwarfed by the effects of the severe scarcity of Treasuries.

The rise in euro GC rates relative to OIS may also reflect an additional factor specific to the way these rates are compiled. Unlike US GC rates that refer to a homogeneous basket of US Treasuries, available euro GC rates (known as “Eurorepo”) are based on a heterogeneous basket of sovereign bonds issued by any of the 15 euro area countries. Specifically, for each available maturity, the European Banking Federation publishes an unweighted average

... and greater availability of sovereign collateral

Rising euro GC repo rates ...



¹⁶ In the United Kingdom, the introduction of the Special Liquidity Scheme (SLS) in April 2008 also appears to have increased the availability of government collateral, as discussed in the next section.

of indicative GC repo quotes contributed by a panel of 37 banks (excluding the highest and lowest 15%).¹⁷ These quotes can refer to repo transactions based on any of the eligible euro sovereign bonds and bills.

This feature seems to have affected the level of the reported Eurepo rates during the financial turmoil, as market participants began increasingly to discriminate between collateral from different countries. Specifically, market participants expressed a clear preference for German and French government bonds over other euro area sovereigns as the crisis intensified. Data on overnight repos for 10-year sovereign collateral show that the spread between single-A rated Greek and AAA-rated German repo rates widened from around zero basis points prior to the Lehman bankruptcy to more than 60 basis points by the end of September. Spreads for a number of other countries also widened substantially during this period (Graph 6). In addition, with segmentation and differentiation among banks based on their size and creditworthiness becoming increasingly prevalent as the crisis deepened, quotes reported by banks may also have become more dispersed. The marked rise in euro GC rates from September onwards therefore seems to have partly reflected the greater dispersion of repo quotes, both across collateral and across banks. Graph 6 clearly displays the widening that has taken place between euro GC rates, as reflected by Eurepo, and German-only collateral rates.

... partly due to greater dispersion of euro sovereign collateral rates

Central bank response and impact on repo markets

Central banks have responded to turmoil in money markets with actions designed to address funding shortages at various maturities.¹⁸ Such responses have also, to varying degrees, reduced strains in GC repo markets. We focus on the central bank actions that have most affected repo markets, namely: (i) the creation of facilities to exchange illiquid collateral for liquid government bonds; and (ii) the broadening of collateral schedules for central bank operations. Overall, the increased supply of government securities available for GC repos has eased some of the downward pressure on GC repo rates relative to OIS, particularly in the United Kingdom. The broadening of collateral schedules has addressed the overhang of illiquid assets on banks' balance sheets and made it easier for banks to raise funds via central bank facilities.

Central banks' actions reduce strains in repo markets ...

... creating facilities to upgrade collateral ...

To address the increased demand for government securities and the unwillingness of cash providers to accept other forms of collateral, the Federal Reserve and the Bank of England created facilities that provided access to

¹⁷ The GC repo rates that we have available for the United Kingdom, which are British Bankers' Association (BBA) repo benchmark rates, are constructed in a similar way. Of the contributions of 12 banks in the BBA panel, the middle two quartiles are averaged to produce the benchmark rates.

¹⁸ For an overview of central bank actions, see BIS (2008) and Borio and Nelson (2008). For studies of the US market, see Armandier et al (2008), Cecchetti (2008) and Fleming et al (2008). For the euro area, see Cassola et al (2008). For the UK market, see recent issues of the Bank of England *Quarterly Bulletin*.

government securities that could be pledged more easily to raise funds.¹⁹ The Federal Reserve introduced the Term Securities Lending Facility (TSLF) in March 2008, while the Bank of England introduced the Special Liquidity Scheme (SLS) in April 2008. The TSLF and SLS allow qualifying institutions to upgrade their collateral through an asset swap, where highly rated but less liquid securities can be exchanged for government securities. Users pay a fee for this service and retain the risk of losses on the posted collateral, which is subject to a haircut and marked to market daily.

Despite their common objective, the TSLF and SLS differ in the form of the facility, the breadth of counterparties, the maturity of the asset swap and the eligible collateral. The TSLF is an auction facility that is available only to the Federal Reserve's 19 primary dealers, who bid weekly to borrow US Treasuries for a 28-day term. The eligible collateral alternates between auctions against a narrow list of eligible collateral (Schedule 1), including agency debt and MBS, and a broader list (Schedule 2), including non-agency MBS, asset-backed securities (ABS), investment grade corporate bonds and municipal securities. The SLS, by contrast, is a standing facility that is open to a large number of banks and building societies. The asset swaps are for an initial period of one year, and may be renewed for up to three years. The SLS accepts only AAA-rated residential mortgage-backed securities (RMBS) and credit card ABS that existed at the end of 2007.

The TSLF and SLS have been modified in the light of market conditions. The amount outstanding under the TSLF was increased twice to reach \$200 billion, the frequency of Schedule 2 auctions was raised, and the auctions were extended over year-end to address funding concerns.²⁰ Bid/cover ratios have fluctuated based on the type of collateral accepted, with notable increases around periods of market stress. Fleming et al (2008) suggest that the TSLF has promoted liquidity while easing stress in US repo markets, as evidenced by the fall in spreads between agency (and agency MBS) repo rates relative to GC (Graph 4).

The SLS does not have a specific size limit. While initial estimates suggested the use would be £50 billion, the SLS reportedly grew to around £200 billion by September. In the light of the severe disruptions around Lehman's bankruptcy, the initial drawdown was extended from October to January 2009. Analysis by the Bank of England suggests that the SLS has been successful in increasing the supply of gilt collateral, as seen in the cheapening of UK GC repo rates relative to OIS.

Central banks have also expanded the list of collateral that counterparties can pledge when borrowing from standing or auction facilities at the central bank. In general, central banks lowered the minimum credit rating and increased the quantity of lending through these facilities. The Federal Reserve,

... that are increased in size and extended over year-end

Central banks broaden collateral schedules ...

¹⁹ Given the relatively large quantity of euro sovereign debt outstanding and the increased supply in auctions, the euro repo market did not experience this sovereign collateral shortage.

²⁰ Auctions of TSLF options were introduced in July 2008, where the option allows for additional draws from the TSLF around key dates such as year-end.

for example, expanded its collateral list for repo operations on three occasions in response to severe market dislocations – in March, May and September 2008.²¹ By the end of this period, the eligible collateral closely matched securities that can be pledged in triparty repo systems, including investment grade corporate bonds and equities. The ECB, by contrast, headed into the crisis with the broadest list of eligible collateral among its peers, including non-marketable securities and commercial loans. As a result, the ECB made no changes until mid-October 2008, when it expanded the eligible collateral significantly and lowered the minimum credit rating from A– to BBB–. Finally, the Bank of England’s approach has been to accept a wider pool of collateral at special sterling long-term repos, held infrequently until late September and weekly thereafter. The standard collateral for Bank of England operations was extended in December 2007 to include AAA-rated ABS, RMBS and covered bonds. The list was then expanded three times in October 2008 to accept a much broader set of securities, as well as lowering the minimum rating on MBS, ABS and covered bonds to single A– and higher.

... and expand their balance sheets

One consequence of these central bank actions has been the increased size of balance sheets at the Federal Reserve, ECB and Bank of England, and a decrease in overall asset quality. Central bank assets rose significantly from mid-September onwards, with the Federal Reserve’s (Graph 5) and Bank of England’s total assets more than doubling in a matter of weeks while the ECB’s assets increased by more than 30% (see Box 4 on pages 18–19 in the Overview for further details).

Longer-term implications for repo markets

The financial crisis that has disrupted unsecured interbank and money markets has also had significant effects on repo markets, despite the presence of collateral. Funding conditions became more restrictive and funding increasingly concentrated in government securities and at very short maturities. Looking forward, what are the implications for repo markets and how are these markets likely to evolve?

A first set of implications relate to the use of repo markets. First, repo financing is likely to remain an important source of capital for banks and financial institutions. The current turmoil has demonstrated that even large and well established counterparties may fall victim to illiquidity or insolvency. Under these circumstances, the importance of collateral will probably grow. Second, the ability and/or willingness to generate leverage using repos may be curtailed in the future. Investment banks and leveraged investors used repos extensively to grow their balance sheets, exposing them to greater funding risk. The decline of this business model is likely to result in lower repo turnover, particularly in the United States. The net effect of these offsetting forces on outstanding repo volumes is unclear. Third, financial institutions will probably

Collateral likely to be more important when raising funds

²¹ By contrast, for discount window lending, the Federal Reserve has consistently accepted a very wide range of collateral, allowing “any assets that meet regulatory standards for sound asset quality”.

make efforts to manage collateral more effectively, and to mobilise it to business areas more quickly – particularly across borders and currencies. Collateral management within financial institutions may therefore grow in importance.

A second set of implications relates to the risk management practices around repos. First, repo market activity has become more concentrated on government securities, with cash providers showing a preference for high-quality collateral that is liquid and widely accepted. It seems likely that the repo markets for structured products or lower-rated collateral may not recover to their previous levels. Second, within the euro repo market, the tiering of sovereign GC collateral reflects different market risk, which in turn is due to perceptions of credit risks and the ease with which the collateral can be sold. This tiering reduces market liquidity and limits the growth of the euro repo market. Third, counterparty credit risk management will probably remain a central concern and suggests that more repo market participants may turn to financial intermediaries such as CCPs to reduce counterparty risk. Fourth, haircuts and initial margin have risen from arguably unsustainably low levels. Higher haircuts are likely to persist, particularly for less liquid collateral types. The higher costs may further contribute to the concentration of activity in GC repos. Market participants may also begin to focus more on daylight exposures, with the potential for marking to market intraday.

A final set of points relates to the operational risks in repo markets. First, US repo markets exhibit a rise in settlement fails during periods of low interest rates, which disrupts the operation of this vital market. The incentives to fail should be addressed by increasing the cost of failing, as seen in the recent proposals from the Treasury Market Practices Group. A second point concerns the triparty repo market, which has grown throughout the crisis, concentrating activity and hence exposures on the balance sheets of a limited number of custodial banks. This concentration needs to be monitored closely. Third, leading central banks have become more active in these markets, expanding the eligible collateral in lending operations, and providing more of a market intermediary role. The extent to which these new operating procedures become permanent or are phased out remains an important question for the future.

Greater focus on top-quality collateral ...

... and on counterparty risk management

Treasury fails to be addressed ...

... while concentration of the triparty repo market remains a concern

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