

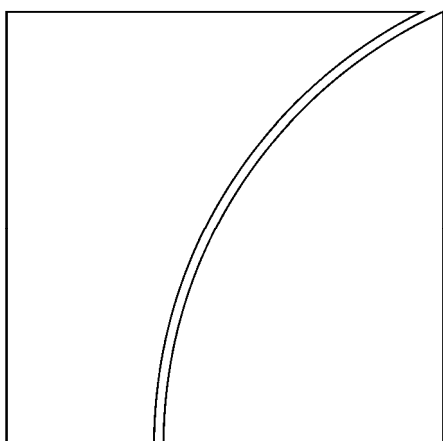


BANK FOR INTERNATIONAL SETTLEMENTS

BIS Quarterly Review

December 2008

International banking
and financial market
developments



BIS Quarterly Review
Monetary and Economic Department

Editorial Committee:

Claudio Borio
Stephen Cecchetti
Már Gudmundsson

Robert McCauley
Frank Packer
Eli Remolona

Philip Turner
Paul Van den Bergh

General queries concerning this commentary should be addressed to Frank Packer (tel +41 61 280 8449, e-mail: frank.packer@bis.org), queries concerning specific parts to the authors, whose details appear at the head of each section, and queries concerning the statistics to Philippe Mesny (tel +41 61 280 8425, e-mail: philippe.mesny@bis.org).

Requests for copies of publications, or for additions/changes to the mailing list, should be sent to:

Bank for International Settlements
Press & Communications
CH-4002 Basel, Switzerland

E-mail: publications@bis.org

Fax: +41 61 280 9100 and +41 61 280 8100

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Notations used in this Review

e	estimated
lhs, rhs	left-hand scale, right-hand scale
billion	thousand million
...	not available
.	not applicable
–	nil
0	negligible
\$	US dollar unless specified otherwise

Differences in totals are due to rounding.

Overview: global financial crisis spurs unprecedented policy actions

Financial stability concerns took centre stage once again over the period between end-August and end-November. In the wake of the mid-September failure of Lehman Brothers, global financial markets seized up and entered a new and deeper state of crisis. As money market funds and other investors were forced to write off their Lehman-related investments, counterparty concerns mounted in the context of large-scale redemption-driven asset sales.

The ensuing sell-off affected all but the safest assets and left key parts of the global financial system dysfunctional. With credit and money markets essentially frozen and equity prices plummeting, banks and other financial firms saw their access to funding eroded and their capital base shrink, owing to accumulating mark to market losses. Credit spreads surged to record levels, equity prices saw historic declines and volatilities soared across markets, indicating extreme financial market stress. Government bond yields declined in very volatile conditions, as recession concerns and safe haven flows increasingly outweighed the impact of anticipated increases in fiscal deficits. At the same time, yield curves steepened from the front end, reflecting repeated downward adjustments in policy rates.

Emerging market assets also experienced broad-based price declines, as depressed levels of risk appetite and associated pressures in the industrialised world spilled over into emerging financial markets. With confidence in the continued viability of key parts of the international banking system collapsing, the authorities in several countries embarked on an unprecedented wave of policy initiatives to arrest the plunge in asset prices and contain systemic risks.

Market developments over the period under review went through four more or less distinct stages. Stage one, which led into the Lehman bankruptcy in mid-September, was marked by the takeover of two major US housing finance agencies by the authorities in the United States. Stage two encompassed the immediate implications of the Lehman bankruptcy and the wide-spread crisis of confidence it triggered. Stage three, starting in late September, was characterised by fast-paced and increasingly broad policy actions, as responses to the crisis evolved from case by case reactions to a more international, system-wide approach. In the fourth and final stage, from mid-October, pricing patterns were increasingly dominated by recession fears, while markets continued to struggle with the uncertainties surrounding the large number of newly announced policy initiatives.

Fannie Mae and Freddie Mac under government control

Financial markets entered September amid growing expectations of a broad-based cyclical deterioration. The prices of financial assets had started to experience downward pressure during the summer as markets adjusted to the outlook of weak earnings, rising defaults and associated financial sector losses. With the hoped-for stabilisation in house prices expected to be still some time off and activity in securitisation markets weighed down by heavy subprime losses (Graph 1, left-hand and centre panels), loss expectations also continued to build for the US government-sponsored housing finance agencies Fannie Mae and Freddie Mac.

Housing markets continue to deteriorate ...

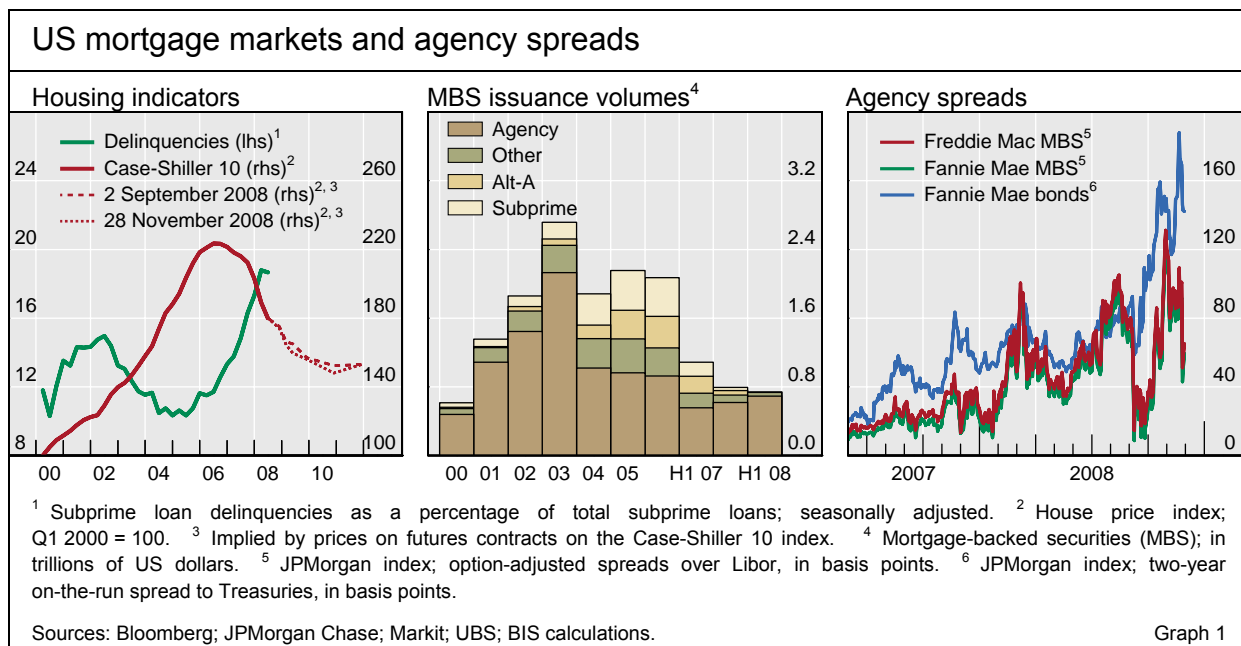
... putting pressure on Fannie and Freddie ...

... which are subsequently taken over by the authorities

In a bid to support the US housing market, which had come to depend on agency securitisation for virtually all remaining mortgage origination activity, the US government formally took control of the two agencies on Sunday 7 September (see Table 1 for a timeline of events). The move had been broadly anticipated and, by essentially making the agencies' formerly implicit guarantees explicit, largely lifted credit risks from both senior and subordinated holders of the agencies' debt. Spreads on agency-sponsored mortgage-backed securities (MBS) and debt instruments (Graph 1, right-hand panel) tightened as a result. In contrast, the remaining value of equity claims was effectively wiped out owing to the government's new senior preferred equity stake, resulting in losses for regional US banks and other holders of the agencies' shares.

The relief provided by these measures proved limited, however. Expectations of further writedowns and losses continued to weigh on other parts of the financial sector. As the macroeconomic outlook darkened, actual announced global losses related to the credit crisis, which had soared to a total of around \$510 billion by the end of August 2008, continued to rise (Graph 2, centre panel). When attention turned away from the US mortgage finance agencies, financial equity prices and credit spreads came under renewed pressure. Weakness in both markets, in turn, added to the problems faced by

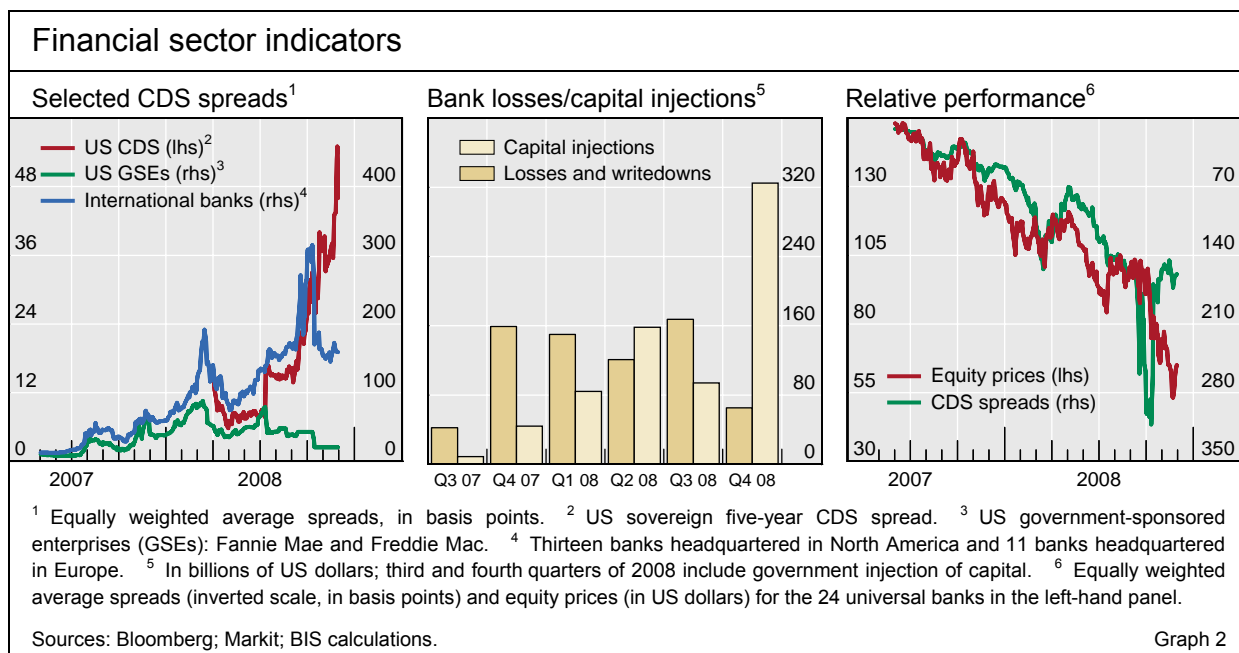
The relief provided by the takeover is short-lived ...



Timeline of key events over the period	
7 September	Two US mortgage finance agencies (Fannie Mae and Freddie Mac) are taken into conservatorship.
15 September	Lehman Brothers Holdings Inc files for Chapter 11 bankruptcy protection.
16 September	Reserve Primary Fund, a US money market fund with more than \$50 billion in assets, “breaks the buck”, triggering large volumes of fund redemptions and contagion effects across money and short-term credit markets; the US government steps in to rescue insurance company AIG.
18 September	UK bank HBOS announces its merger with rival Lloyds TSB; new round of coordinated central bank measures address the squeeze in US dollar funding with \$160 billion in new or expanded swap lines; the UK authorities prohibit short selling of financial shares.
19 September	The US Treasury announces a temporary guarantee for money market fund investors; the SEC announces a ban on short sales in financial shares; early details emerge of a \$700 billion US Treasury proposal to remove troubled assets from bank balance sheets (the Troubled Asset Relief Program, TARP).
29 September	UK mortgage lender Bradford & Bingley is nationalised; banking and insurance company Fortis receives a \$16 (€11.2) billion capital injection; German commercial property lender Hypo Real Estate secures a government-facilitated credit line (subsequently raised to \$70 (€50) billion); troubled US bank Wachovia is taken over; the proposed TARP is rejected by the US House of Representatives.
30 September	Financial group Dexia receives a \$9 (€6.4) billion capital injection; the Irish government announces a guarantee safeguarding all deposits, covered bonds and senior and subordinated debt of six Irish banks; other governments follow up with similar initiatives or expand existing guarantee schemes over the following weeks.
3 October	The US Congress approves the revised TARP plan.
7 October	The US Federal Reserve announces the creation of a new Commercial Paper Funding Facility aimed at buying three-month unsecured and asset-backed commercial paper.
8 October	Major central banks undertake a coordinated round of policy rate cuts; the UK authorities announce a comprehensive support package, including capital injections for UK-incorporated banks and guarantees for new short- to medium-term senior unsecured bank debt.
13 October	Major central banks jointly announce measures to improve liquidity in short-term US dollar fund markets, supported by uncapped US dollar swap lines between the Federal Reserve and the other central banks; euro area governments pledge system-wide bank recapitalisations and guarantees for new bank debt.
14 October	The US government announces that up to \$250 billion of previously approved TARP funds are to be used to recapitalise banks; 9 large US banks agree to public recapitalisation.
21 October	The US Federal Reserve announces the creation of a new Money Market Investor Funding Facility, under which it will finance the purchase of short-term debt from money market funds.
28 October	Hungary secures a \$25 billion support package from the IMF and other multilateral institutions aimed at stemming growing capital outflows and related currency pressures.
29 October	To counter the spread of difficulties in obtaining US dollar funding, the US Federal Reserve establishes US dollar swap lines with the monetary authorities in Brazil, Korea, Mexico and Singapore.
12 November	The US Treasury announces that TARP funds previously earmarked for the purchase of troubled assets will be reallocated to supporting consumer credit.
23 November	The US government agrees to protect \$306 billion worth of loans and securities on Citigroup’s books and to inject \$20 billion of cash in return for a \$27 billion preferred equity stake
25 November	The US Federal Reserve announces the creation of a \$200 billion facility to extend loans against securitisations backed by consumer and small business loans; under another programme, up to \$500 billion will be used for purchases of bonds and mortgage-backed securities issued by Fannie Mae, Freddie Mac and the Federal Home Loan Banks.

Sources: Bank of England; Federal Reserve Board; Bloomberg; *Financial Times*; *The Wall Street Journal*.

Table 1



the affected institutions in replenishing their capital bases and satisfying their ongoing funding needs (Graph 2, left- and right-hand panels). Strains mounted mainly for market participants primarily dependent on wholesale funding and known to be exposed to troubled assets, including the major standalone investment banks.

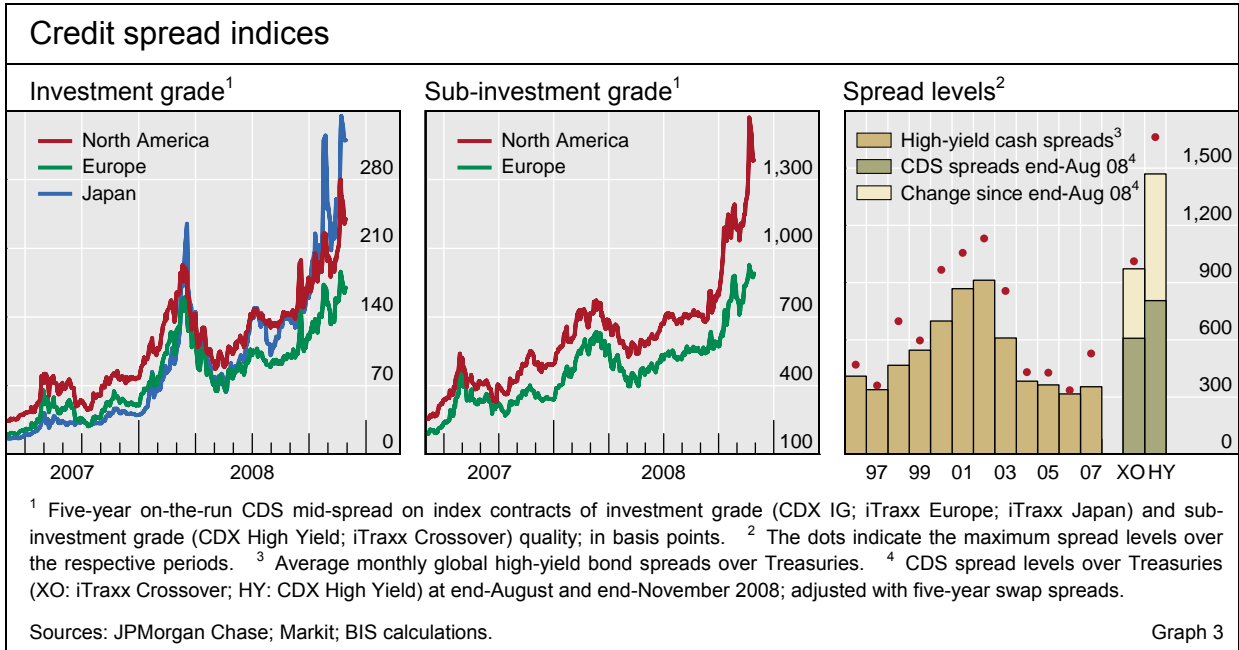
Lehman Brothers, in particular, faced increasing pressures. When, on 9 September, a large Asian investor pulled out of talks about a long-awaited capital injection, the company's already depressed stock price was pushed further down. Weak results for the third quarter of 2008 were released the following day. Despite the simultaneous announcement of plans to spin off major business units in a bid to raise funds, confidence in the ability of Lehman's management to secure urgently needed funding faded quickly. This, in turn, triggered speculation that the authorities would try to arrange a solution over the following weekend.

... with Lehman Brothers facing particular problems

Lehman Brothers bankruptcy triggers confidence crisis

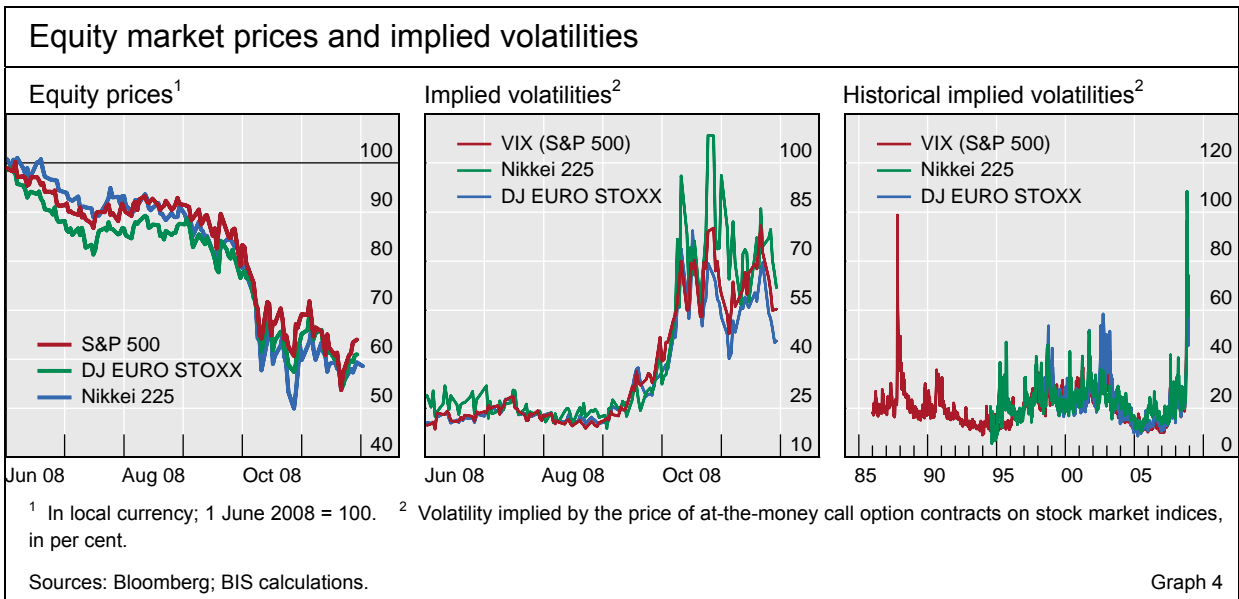
In this environment of tension over the continued viability of Lehman Brothers, financial market developments entered a completely new phase. The spotlight was now being turned on the ability of key financial institutions to maintain solvency in the face of accumulating losses. The trigger for this new and intensified stage of the credit crisis came on Monday 15 September. That day, following failed attempts by the US authorities to broker a takeover by another financial institution over the weekend, Lehman Brothers Holdings Inc filed for bankruptcy protection, one of the biggest credit events in history.

The Lehman failure ...



... causes
 counterparty risks
 to mount ...

The turmoil in financial markets intensified and quickly spread from credit and money markets into the global financial system more broadly (see Box 1 for details on the Lehman bankruptcy and some of its implications). With perceptions of counterparty risk rising, the benchmark US investment grade CDX credit default swap (CDS) index spread jumped by 42 basis points on 15 September alone, and US high-yield spreads rose 118 basis points. Credit spreads in other major markets increased by similar amounts (Graph 3, left-hand and centre panels) and continued to move in tandem with US markets through the remainder of the period. As a result, at their peak, US high-yield CDS spreads reached an all-time high some 500 basis points above the highest comparable cash spreads realised at the height of the telecom bust in September 2002 (Graph 3, right-hand panel). Equity prices fell by some 4% in the United States and Europe on the day of the Lehman bankruptcy, and other stock markets declined by similar amounts (Graph 4, left-hand panel).



Box 1: Three market implications of the Lehman bankruptcy

Ingo Fender, Allen Frankel and Jacob Gyntelberg

Lehman Brothers Holdings Inc (LBHI) filed a petition under Chapter 11 of the US bankruptcy code on 15 September, listing consolidated bank and bond debt of more than \$600 billion; its US broker-dealer subsidiary was acquired by Barclays a few days later. The filing marked the first failure of a major investment bank since the demise of Drexel Burnham Lambert in February 1990. Lehman's problems originated from large-scale losses and writedowns taken on exposures to troubled assets and concerns that future losses would outstrip the company's previous efforts to replenish its capital base (Graph A, centre panel). As such, its failure revived questions about investment banks' highly leveraged balance sheets and associated dependence on wholesale funding that had been raised when Bear Stearns had nearly failed in early 2008. Thus, when confidence in the continued viability of the company collapsed (Graph A, left-hand panel), its access to wholesale markets was cut off, forcing Lehman into bankruptcy.^①

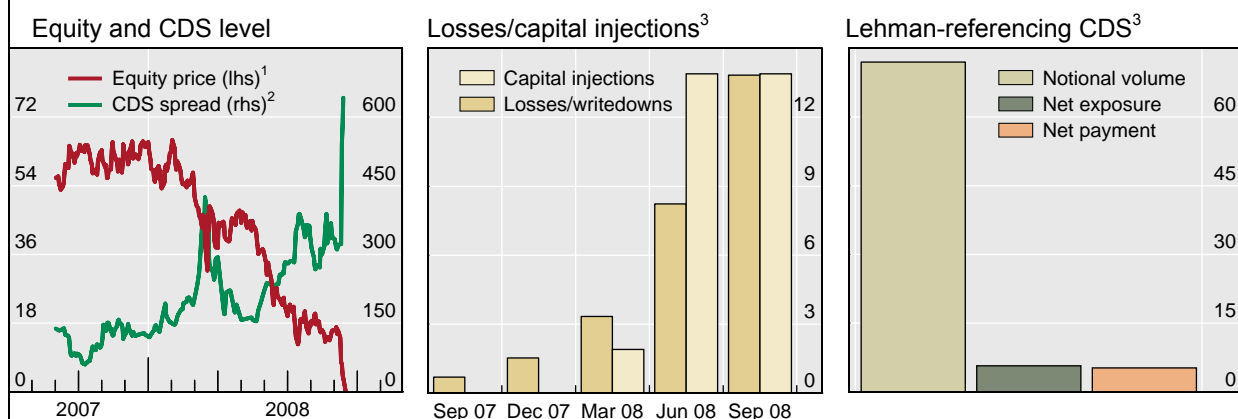
An event of this magnitude obviously raised a multitude of issues, given the company's size and its central position as a dealer and counterparty in a variety of financial markets. This box discusses three particular market implications linked to the failure of Lehman Brothers that had the potential to cause systemic liquidity disturbances: (1) the impact on the CDS market; (2) the liquidation of money market funds due to losses suffered on Lehman debt; and (3) the consequences of the bankruptcy for the company's prime brokerage clients.

(1) CDS markets

The potential fallout of a Lehman bankruptcy in the \$57.3 trillion CDS market^② was the one issue that attracted most attention in the days surrounding the company's bankruptcy filings. The concerns arose from Lehman's central role as a major counterparty and reference entity in that market. It was known that its bankruptcy filing would have two immediate effects: it would trigger default clauses in CDS contracts referencing Lehman, and it would terminate the contracts that the firm had entered into as a counterparty. Netting, settlement and replacement of the respective positions were known to raise operational risks. More importantly, however, no hard public information on the volume of CDS contracts referencing Lehman or the net amounts required to settle them was available at the time of the bankruptcy. The absence of such information created great uncertainty about the capacity of already strained money markets to accommodate the anticipated corresponding liquidity needs.

To manage the situation and address the uncertainties involved, the following initiatives were undertaken. First, a special trading session was organised on Sunday 14 September, right before the bankruptcy filing. The objective was to help the main CDS dealers net out counterparty positions involving Lehman and to rebalance their books through the replacement of trades. Second,

Lehman Brothers: selected indicators



¹ In US dollars. ² In basis points. ³ In billions of US dollars.

Source: Bloomberg.

Graph A

following established ISDA (International Swaps and Derivatives Association) procedures, an auction among CDS dealers was conducted on 10 October to determine the recovery rate to be used in the cash settlement of CDS contracts referencing Lehman and, thus, the net amounts to be exchanged between parties.⁹ Third, the DTCC (Depository Trust and Clearing Corp) made public its count of \$72 billion worth of outstanding CDS contracts referencing Lehman and an estimate of \$6 billion for related net settlement payments. In the end, on 21 October, a total of \$5.2 billion in net payments were made on such contracts (Graph A, right-hand panel). While these relatively modest volumes had no noticeable impact on liquidity conditions at the time of settlement, earlier uncertainties related to these claims are likely to have contributed to volatile conditions in money markets following the bankruptcy filing. Added strains from a potential failure of insurer AIG, in turn, were averted only through a government rescue.

(2) Money market funds

A major source of funding for Lehman was its issuance of commercial paper and other forms of short-dated debt. Money market funds were attracted to these securities by their high credit ratings and yield premiums relative to US government paper. Money market fund investors also felt protected against principal loss because of regulatory restrictions imposed on fund managers and because fund managers had avoided losses in the past.

In the aftermath of the Lehman bankruptcy, 25 money market fund advisers took actions to protect their investors against losses on the company's debt. However, the net asset value of a public money market fund, Reserve Primary, fell below \$1.00 per share. As a result, the fund was to be liquidated and distributions made to investors as cash accumulated either through the maturing of portfolio holdings or their sale.

The fund's liquidation prompted massive redemptions by investors in other US money market funds, especially "prime" funds invested in commercial paper. To stop the run on these funds, the US Treasury instituted a temporary programme of insurance for money market fund investors, which was followed up by Federal Reserve rescue programmes aimed at outright purchases of commercial paper and of short-term debt from money market funds (see Box 2 on recent government initiatives).

(3) Prime brokerage activities

Lehman was managed as a global firm, which involved in particular the centralisation in the United States of its funding activities. Despite the global nature of the firm, separate administration and bankruptcy applications were filed by Lehman outside the United States and by the parent firm in New York. These filings in different jurisdictions made this one of the first truly global bankruptcies of a large and complex financial institution. The complexity of the Lehman operation, and the takeover of its US broker-dealer subsidiary immediately after the holding company's bankruptcy filing, raised questions related to the use of different legal procedures across countries for a collapsed firm that was previously managed and run along global product lines. One manifestation of the resulting issues concerns Lehman's prime brokerage activities.

Lehman provided prime brokerage services to a large number of hedge funds. As part of these prime brokerage relationships, hedge funds placed investment assets with Lehman's broker-dealer units in different jurisdictions. These assets, posted as collateral for funding activities, could then be reused by Lehman to meet its own obligations, a process called re-hypothecation. Given its insolvency, many of Lehman's prime brokerage clients suddenly lost access to (and, potentially, part of their claims on) their collateral assets for the duration of the administration process. They were thus forcibly locked into positions of changing value whose future accessibility would depend on different legal proceedings and contractual arrangements in various jurisdictions. To the extent that this resulted in adjustments to the size and location of hedge funds' activities with their prime brokers, the reallocation of funds across jurisdictions, combined with attempts to reduce leveraged risk exposures, would generate potentially sizeable asset sales and withdrawals from individual prime brokerage accounts. These transactions, in turn, would add to pressures in funding and securities lending markets in the wake of the Lehman bankruptcy.

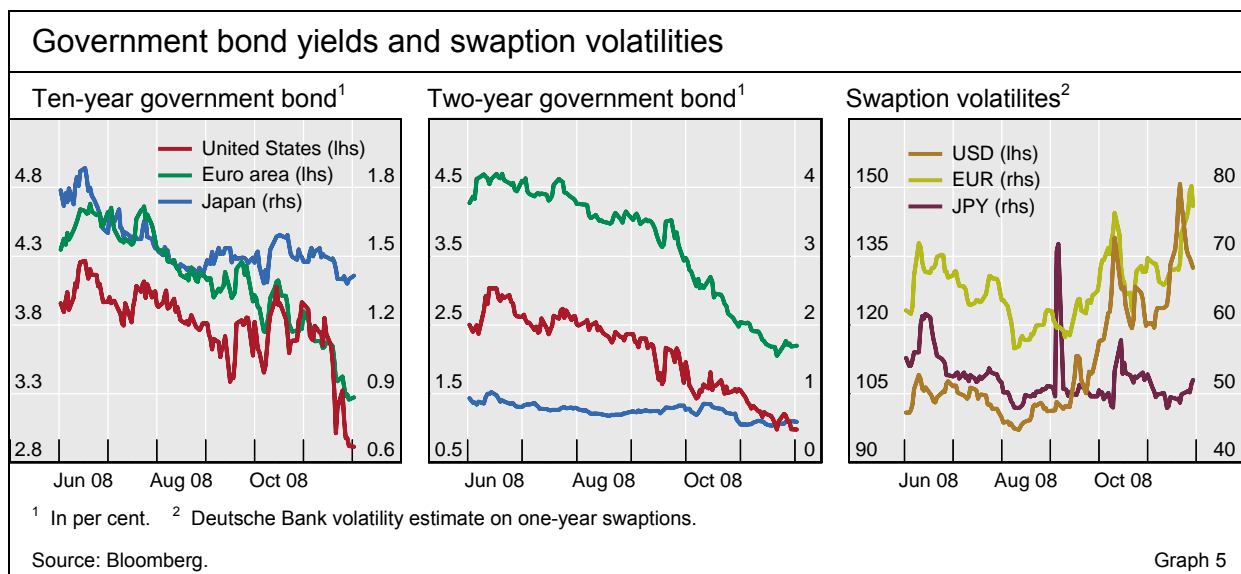
⁹ On similar cases of bank run-type effects in financial markets, see C Borio, "Market distress and vanishing liquidity: anatomy and policy options", *BIS Working Papers*, no 158, July 2004. ¹⁰ CDS market size is usually measured in notional amounts, while replacement costs are better captured by gross market values (estimated at an overall 5.5% of notional market size in mid-2008). ¹¹ The auction process, defined by ISDA's 2008 Lehman CDS protocol, set the recovery value for Lehman bonds at 8.625%, based on quotes submitted by 14 dealers. As Lehman's bonds had been trading increasingly lower since its bankruptcy filing, the auction price was only slightly lower than bond prices right before the auction, limiting the "gap risk" arising from the auction process.

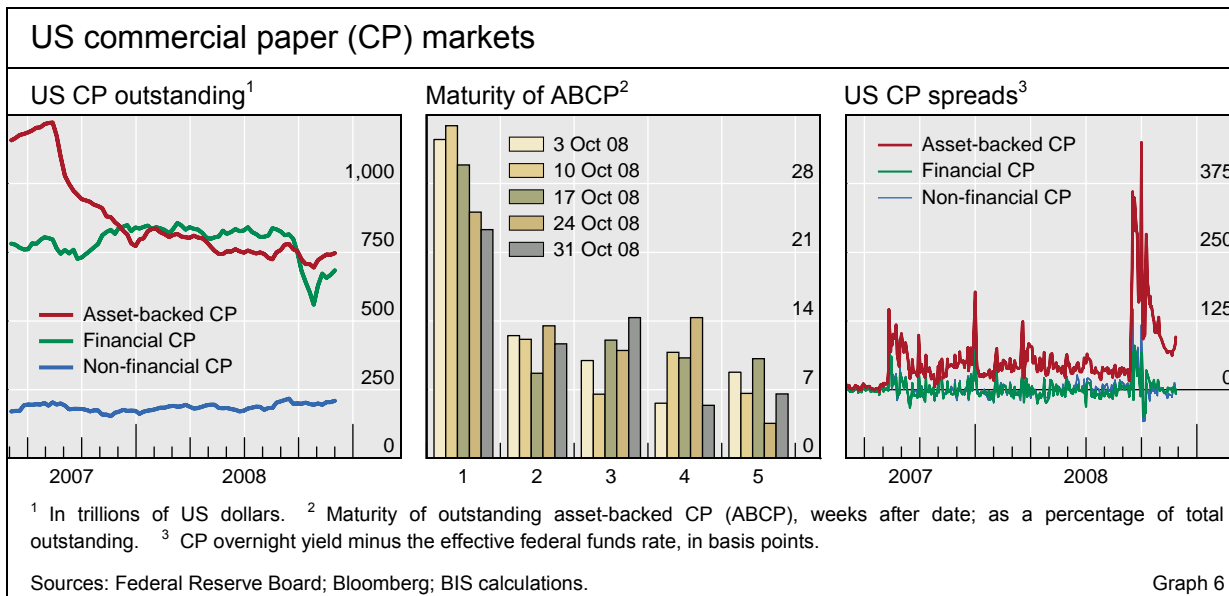
Longer-term government bond yields also declined (Graph 5, left-hand panel) and foreign exchange carry trades started to be unwound as the developing crisis of confidence resulted in a renewed flight to quality. Volatilities spiked across markets (Graphs 4 and 5, right-hand panels) and climbed even further in the following weeks as investors withdrew from all but the safest assets.

... with pressures spreading quickly across markets

Concerns related to the Lehman bankruptcy initially centred on the firm's role as a broker and key counterparty in the CDS market. In the first half of 2008, unprecedented CDS terminations had reduced outstanding volumes of existing CDS trades by \$17.4 trillion worth of closed-out offsetting positions (see the highlights section on pages 25–35 for more detail on CDS volumes). More specific attempts by key CDS counterparties to adjust their exposures to Lehman were aided by a special trading session on Sunday 14 September, the day before the bankruptcy filing. However, worries about CDS exposures grew further when, late on 15 September, AIG, a large US insurer with substantial CDS positions, had its credit ratings downgraded by all major rating agencies. These downgrades, in turn, were known to trigger sizeable collateral calls by counterparties of AIG's financial products unit and early termination of additional contracts. In response, intraday on 16 September, most major CDS indices rose above their March peaks and receded only on speculation that the insurer would receive some kind of assistance. Government support materialised later that day, when a decision was made to extend an \$85 billion loan under Section 13(3) of the Federal Reserve Act (which allows loans to non-banks under "unusual and exigent circumstances") to avoid the disorderly failure of AIG and its prospective effects on already fragile markets. The loan would later be restructured and supplemented by additional facilities totalling \$27.5 billion, with the US government receiving a stake of up to 79.9% in the company in return.

Initial concerns are centred on the CDS market ...





... but quickly refocus on traditional debt ...

With the immediate concerns about CDS markets alleviated, traditional exposures to Lehman's outstanding debt securities turned out to be of even greater importance. The systemic nature of those exposures became fully apparent the day after the bankruptcy filing. It was then that Reserve Primary, a major US money market mutual fund, wrote off \$785 million worth of short- and medium-term notes issued by Lehman. As a result, Reserve Primary became the first money market mutual fund in 14 years to "break the buck", ie to report less than one dollar's worth of net assets for each dollar invested. This triggered unprecedented volumes of US money market fund redemptions. Between 10 and 24 September alone, investors pulled out \$184 billion, forcing fund managers to liquidate assets into essentially illiquid markets. Short-term credit and money markets froze.

... and spillovers into the money ...

... and CP markets

Commercial paper (CP) markets, in which money market funds are traditionally the largest investor group, were among the first to suffer from the ensuing wave of redemptions and reallocations. In contrast to similar spillovers during the onset of the credit crisis in the summer of 2007, both asset-backed and non-asset backed CP markets were hit hard (Graph 6, left-hand panel). Unsecured financial paper suffered the largest outflows, adding pressure to already strained markets for bank funding. Durations shortened and borrowing rates shot up. Outstanding CP volumes in the United States plummeted by more than \$325 billion from a total of about \$1.76 trillion on 10 September (Graph 6, centre and right-hand panel). Volumes would start to recover only in late October, following the announcement and subsequent initiation by the Federal Reserve of a new facility to buy both unsecured and asset-backed CP.

Money markets freeze ...

Confronted with soaring demand for liquid funds in the wake of the contraction in the money market mutual fund sector, global interbank markets seized up, curbing banks' access to short-term funding. Money markets had already been strained for over a year and had failed to recover even with massive central bank liquidity injections. But conditions abruptly deteriorated even further as of mid-September, when the Lehman bankruptcy caused a

Box 2: Government-led bank rescue initiatives

Dietrich Domanski and Srichander Ramaswamy

Government initiatives to strengthen bank balance sheets have evolved from a case by case approach to system-wide intervention. Until September, governments injected capital into individual institutions to avoid their failure and facilitate mergers. This strategy essentially rested on the premise that massive support through liquidity operations by central banks would at some point encourage other banks to lend to each other. As this could not prevent the rapid erosion of market confidence, governments in virtually all advanced economies announced more comprehensive initiatives to stabilise banking systems in late September and early October.

The government initiatives tackled the crisis of confidence on two fronts: one set of measures aimed at ensuring bank funding through explicit government guarantees on retail deposits and other bank liabilities; another set aimed at reducing bank leverage through government purchases of distressed assets or capital injections (see the table).

The announcement of government programmes had a strong signalling effect. Bank CDS spreads fell and funding market conditions stabilised. However, programmes are being modified as the crisis evolves, and details still need to be spelled out in many cases. As a consequence, the impact of government measures on competition and incentives in the financial industry remains uncertain, and whether these measures are sufficient to restart financial intermediation in the broader economy is yet to be seen.

Elements of government programmes announced in September and October

Expansion of retail deposit insurance. Guaranteeing retail bank deposits has been widely used to ensure continued access to deposit funding. The amounts covered by the deposit guarantee schemes have varied substantially across countries, with some extending a blanket guarantee of retail deposits.

Guarantee of wholesale liabilities. To address the drying-up of the wholesale funding market, many governments have announced state guarantees on bank wholesale debt. The range of liabilities covered and fee structures vary widely across countries, with some charging a flat fee and others linking fees to bank CDS spreads.

Capital injections. Direct capital injections have been the main mechanism used to directly support balance sheets. Cross-country differences in instruments and conditions of capital injections have also been considerable. For instance, dividend payments on government preferred shares ranges from 5 to 12.5%. Moreover, some countries impose restrictions on executive compensation and/or dividend payments to common shareholders.

Asset purchases. While removing distressed assets from bank balance sheets is part of several programmes, it has not yet been used on a substantive scale. One issue is determining the price at which the government purchases distressed assets. A substantial support to bank balance sheets may require a purchase price close to par – which may effectively amount to a covert recapitalisation. Moreover, the range of eligible assets might have to cover all distressed credit instruments to have a strong and immediate impact on market confidence. This would require large programmes.

Side effects of government intervention

Impact on broader credit markets. Government guarantees affect the relative price of credit. An extension of the pool of government-guaranteed debt may, other things equal, increase the relative cost of borrowing for debt instruments that are close substitutes for bank debt. For instance, the increase in the spreads of GSE debt in early October could be attributable to this effect. Moreover, the combination of different government actions may complicate assessing and pricing the relative credit risk of various forms of bank liabilities. With capital injections, governments typically take junior positions in the capital structure of banks. This may be interpreted as an implicit state guarantee on all existing liabilities. While the stabilisation benefits of government guarantees are likely to outweigh the costs associated with such market distortions in the near term, a clear exit strategy appears important to limit adverse effects on credit markets in the medium term.

Cross-border issues. While rescue plans follow common principles, national differences in their concrete design and practical implementation are considerable. Differences in the scope and price of government guarantee schemes for new debt issuance may put banks in different jurisdictions at a disadvantage in wholesale funding markets as funding costs will become a function of the specific insurance fee structure and of the solvency of the country that provides the guarantee of bank liabilities. In the extreme case, sovereign risk may be used as a proxy to assess the credit risk of bank debt. Another issue concerns retail deposits in foreign-owned banks, for in many cases there is little clarity about how foreign depositors would be treated in the event of bank failure. The instrument choice and terms for capital injection may also affect competitive positions in global markets. One aspect is differences in the effective cost of capital provided by governments. Another is that the terms of capital injections, and the associated conditions, may affect access to private equity capital.

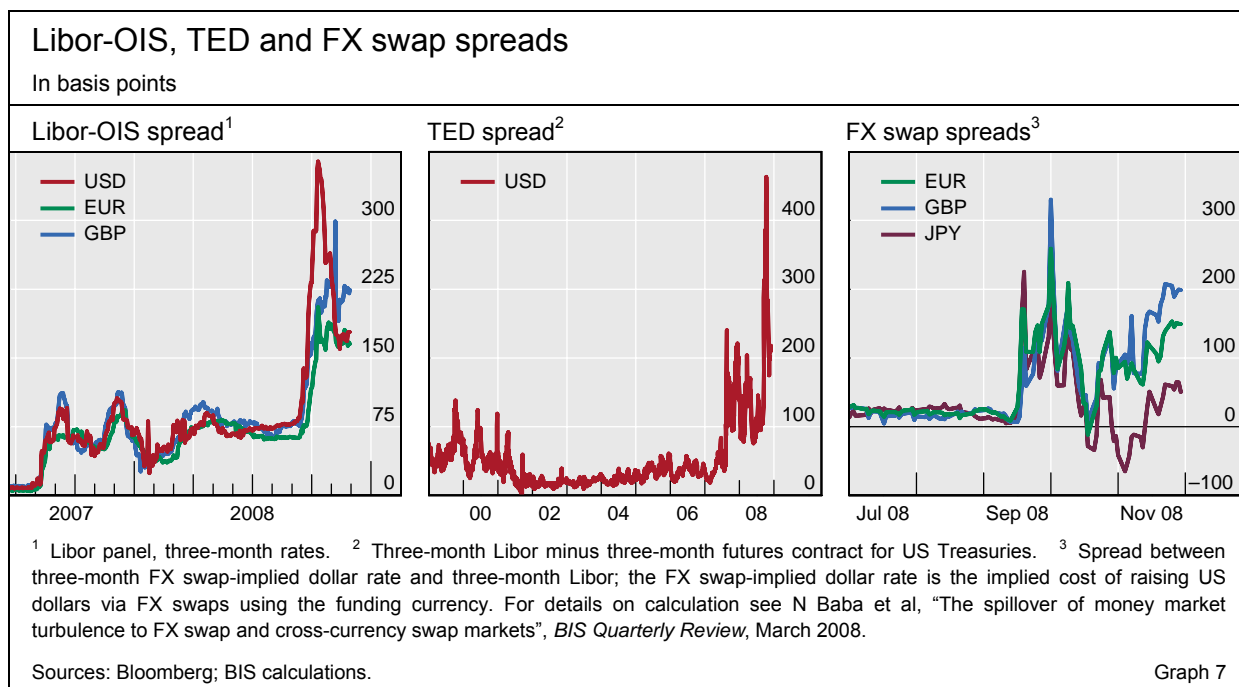
Elements of banking system rescue plans in developed economies¹

Country	Expansion of retail deposit insurance	Guarantee of wholesale liabilities ²		Capital injections ³	Asset purchases
		New debt	Existing debt		
Australia	✓	✓	✓		✓
Austria	✓	✓		✓	
Belgium	✓	✓			
Canada		✓			✓
Denmark	✓	✓	✓		
Finland	✓				
France		✓		✓	
Germany	✓	✓		✓	✓
Greece	✓	✓		✓	
Ireland	✓	✓	✓		
Italy		✓		✓	
Netherlands	✓	✓		✓	
New Zealand	✓				
Norway					✓
Portugal	✓	✓			
Spain	✓	✓		✓	✓
Sweden	✓	✓		✓	
Switzerland				✓	✓
United Kingdom	✓	✓		✓	
United States	✓	✓		✓	✓

¹ As of mid-November 2008. ² Includes bond issuance, interbank lending and other wholesale liabilities. Coverage of the guarantee on these items varies across countries. ³ Refers to announced programmes only (excluding standalone actions).

Source: BIS.

complete collapse of confidence in the financial health of money market counterparties. With banks hoarding liquidity, interbank rates soared to historical highs. Spreads between US dollar Libor and corresponding overnight index swap (OIS) rates, which reflect a combination of counterparty credit risk and liquidity factors, rose from near 80 basis points in early September to 232 basis points at the end of the month. Treasury-eurodollar (TED) spreads reacted similarly (Graph 7, left-hand and centre panels). While movements in other markets, such as those for euro and sterling funds, were somewhat less violent, they still showed clear signs of a major disruption (Graph 7, left-hand panel). At the same time, rising financial sector credit spreads and the surging



global demand for US dollar funds also manifested themselves in related markets: the market for foreign exchange swaps saw historically high spreads for various key industrialised country and emerging market currencies vis-à-vis the US dollar (Graph 7, right-hand panel).

Amid largely dysfunctional wholesale funding markets, policymakers stepped up the pace and scope of their initiatives. On 18 September, in a sign of growing pressures, UK bank HBOS was forced into a government-brokered merger with one of its competitors. On the same day, in an effort to take pressure off the financial sector, the UK Financial Services Authority suspended the short selling of financial stocks. This move was emulated the following day by the authorities in the United States. Major central banks, in turn, reacted with a new round of coordinated measures to address the squeeze in US dollar short-term funding. Notably, they signed new or significantly enlarged currency swap facilities worth \$180 billion (see Boxes 2 and 3 for details on government-led bank rescue initiatives and measures taken to alleviate foreign currency liquidity shortages, and Box 4 on the impact of these initiatives on central bank balance sheets). These actions were followed on 19 September by the US Treasury's announcement of a temporary guarantee for money market fund investors, aimed at arresting the escalating run on the US money market mutual fund sector. Redemptions slowed in response, with total assets gradually rising back to their levels before the Lehman failure, reaching \$3.6 trillion by early November.

... forcing a first round of policy measures

While markets reacted with signs of relief, the pressure on banks and other financial sector firms failed to recede. The policy measures taken hitherto, and early details of a \$700 billion US proposal to take troubled assets off the books of financial institutions, helped credit spreads retreat temporarily from the highs reached immediately after the Lehman bankruptcy. Equity markets also recovered, aided in part by the new ban on short sales. The S&P 500 rebounded by 4% on 19 September, with several high-profile banking

stocks rising even more sharply, and European stock markets gained more than 8% on the same day. Similarly, there were signs of growing expectations that observed dislocations in funding markets would not persist: forward US dollar markets slowly started to point to a notable decline in three-month Libor-OIS spreads over the coming months. Even so, on Sunday 21 September, reflecting the continuing funding squeeze and associated concerns about counterparty risk, investment banks Goldman Sachs and Morgan Stanley obtained permission from the US authorities to convert themselves into bank holding companies. The move was aimed at halting ongoing transfers of counterparty positions and client funds to third parties, with CDS spreads for both credits tightening sharply as a result.

Policy responses to a global confidence crisis

Decisive action is taken ...

At this point, mounting financial sector problems forced the authorities in an increasing number of countries to take decisive action in support of key financial institutions. On 25 September, the US authorities took over Washington Mutual, the largest US thrift institution, and sold its banking assets to a larger rival. In European countries as well, a variety of measures were taken in quick succession to counter threats to the stability of individual institutions within national banking systems. Following negotiations over the weekend, the United Kingdom moved on Monday 29 September to nationalise mortgage lender Bradford & Bingley, while banking and insurance company Fortis received a capital injection from the Belgian, Dutch and Luxembourg governments. Fortis eventually had its Dutch activities nationalised and most of its remaining assets bought by one of its French peers. Also on 29 September, German commercial property lender Hypo Real Estate secured a government-facilitated credit line provided by a consortium of financial sector institutions.

... though the stalling of a comprehensive package shakes markets

Despite such dramatic actions aimed at individual institutions, financial markets were by now focused on the need for comprehensive approaches. Later on 29 September, the US House of Representatives voted to reject the first version of the Treasury's proposed \$700 billion rescue plan for the US financial industry (it was passed into law in revised form at the end of the week). The response to the rejection by the House was immediately visible in US equity markets, which suffered steep declines in a matter of minutes and continued to sell off during the day. The S&P 500 fell 8.8%, led again by financial shares; other indices also declined, though by smaller percentage amounts (Graph 4, left-hand panel).

Individual bank rescues ...

Losses deepened during the following days as further bad news on financial sector health prompted an even sharper weakening of investor confidence. A capital injection by the Belgian, French and Luxembourg governments for financial group Dexia was announced on 30 September. This was followed by initiatives in Ireland and, in response, other countries granting new or raising existing guarantees for bank deposits and similar claims.

Box 3: Central bank measures to alleviate foreign currency funding shortages

Corrinne Ho and François-Louis Michaud

What had been mainly a US dollar liquidity problem for European banks turned into a broader phenomenon in September 2008. The seizing-up of money markets in the second half of September and early October rendered it exceptionally difficult to obtain US dollar funding in both uncollateralised and collateralised markets. Banks in emerging markets, which had until then been relatively little affected by the strains in the dollar money markets, also became embroiled in funding shortages. Moreover, these shortages were no longer in US dollars only. Some financial institutions with foreign currency liabilities in euros and Swiss francs also faced similar funding difficulties.

The spreading of foreign currency shortages has led to a variety of central bank responses. There are three main ways for a central bank to provide foreign currency funding to its counterparties. It can mobilise its existing foreign exchange reserves; it can use foreign exchange borrowed from the market; and it can use foreign funds borrowed from another central bank, including the central bank of issue.^① All three options have precedents, but in the current financial crisis, the first and the last have been more widely used.^② In particular, borrowing from another central bank under swap or collateralised lending arrangements may be preferred when there are insufficient foreign reserves in the needed currency, when there is unwillingness to dip into existing foreign reserves, or when there is concern that selling less liquid foreign reserve assets might reinforce negative market dynamics. Moreover, as illustrated by recent events, the desire to demonstrate a cooperative approach to the problem is also a strong reason for engaging in inter-central bank arrangements instead of – or in addition to – using one's own foreign reserves.

Inter-central bank swap lines and collateralised lending

The use of inter-central bank swap lines – most notably those with the Federal Reserve – has received much attention.^③ This is not only because the crisis originated in the dollar market, but also because the swap lines expanded considerably in both scale and scope over the past year (see the table). Between December 2007 and mid-September 2008, only the ECB and the Swiss National Bank (SNB) used swap lines with the Federal Reserve to deliver US dollar funds to their counterparties, complementing the Federal Reserve's Term Auction Facility. These two transatlantic swap lines had been increased in size over time to support larger dollar operations. With the intensification and spread of US dollar shortages in mid-September, swap lines with the Federal Reserve grew in number (from two to 14 by late October), time zone and geographical coverage (from one continent to five), and size. In particular, the maximum limits for the SNB, ECB, Bank of England and Bank of Japan were lifted in mid-October to allow them to conduct full-allotment US dollar operations at fixed rates. The range of US dollar distribution operations on offer at partner central banks also broadened from mainly longer-term (one- and three-month) offers to include one-week and, for a period, overnight^④ offers as well, and from mainly repos and collateralised loans to include FX swaps.

There are also arrangements in euros and Swiss francs, albeit on a more regional basis. In May 2008, the central banks of Sweden, Norway and Denmark announced an agreement to swap euros for Icelandic krónur with the Central Bank of Iceland. In October 2008, the ECB and the SNB entered into a swap arrangement to facilitate the distribution of Swiss franc funding in the euro area, particularly to smaller banks that did not have direct access to SNB market operations. In the same month, the ECB established a swap line with the National Bank of Denmark to support the latter's efforts to improve liquidity in euro short-term markets and agreed to provide euros to Magyar Nemzeti Bank of Hungary via a repo agreement. In November, the SNB and the ECB concluded Swiss franc- and euro-supplying agreements, respectively, with the National Bank of Poland.

A number of these arrangements, though publicly announced, have not been drawn upon. This suggests that these arrangements signal precaution and the availability of a backstop, rather than an immediate need for actual external financial support.

Drawing on existing foreign reserves

Central banks have also deployed their existing foreign reserves to alleviate foreign currency shortages. Since the onset of the more acute phase of the financial turmoil in mid-September 2008, most major emerging market central banks have conducted *outright sales* of foreign reserves to

help meet the local market's demand for foreign currency funding, as well as to relieve pressure on the exchange rate.^① In addition, some central banks have sought to offer foreign reserves to counterparties under *repurchase agreements* (eg Brazil, the Philippines). A complementary method is to conduct foreign currency-providing *FX swap transactions* with counterparties. For central banks that have long counted FX swaps among their normal money market operations (eg Australia), this method constitutes only an extension of purpose of an existing tool and does not require a new tool. Some central banks have announced modifications (eg widening of counterparty eligibility, extension of term) to their existing FX swap facilities to make the distribution of foreign currency more efficient and flexible (eg Korea, Indonesia). Others have set up new swap facilities (eg Brazil, Chile, Poland) or announced their readiness to conduct swaps with counterparties as needed (eg Hong Kong SAR). Moreover, some central banks also stand ready to be on both sides of FX swap transactions (eg Hungary), helping to ameliorate counterparty credit concerns.

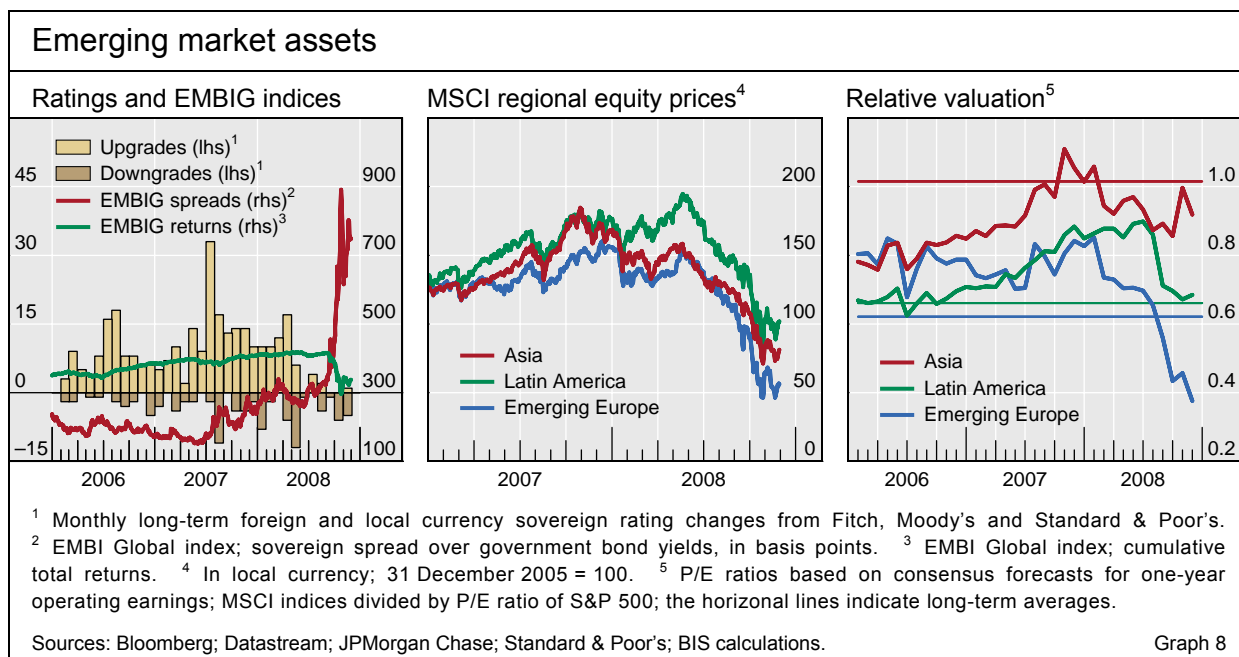
^① In some cases, such borrowing may be done in conjunction with other official financial assistance, such as that from the IMF. ^② Apart from injecting foreign exchange, a central bank can also use other measures, such as changing the reserve requirement framework, to improve the availability of foreign currency funds in the financial system. ^③ Swap lines are by no means a novel policy option, though historically they have been used to support foreign exchange market interventions rather than to alleviate foreign currency funding difficulties. ^④ The daily overnight dollar auctions offered by the ECB, the SNB and the Bank of England between mid-September and mid-November 2008 (mid-October for the ECB) aimed specifically at alleviating dollar shortages early in the European trading day. ^⑤ With the usual dollar funding channels (borrowing and FX swap market) impaired, many firms reportedly turned to the spot market to purchase dollars, resulting in sharp depreciations of the local currencies.

Announced inter-central bank arrangements¹

Partners	First announced	Max amount	Drawn	Supported operations ²
Federal Reserve providing USD:				
Swiss National Bank	12 Dec 07	–	Yes	1M, 3M, 1W
European Central bank	12 Dec 07	–	Yes	1M, 3M, 1W; and FX swaps
Bank of England	18 Sep 08	–	Yes	1M, 3M, 1W
Bank of Japan	18 Sep 08	–	Yes	1M, 3M
Bank of Canada	18 Sep 08	\$30 bn		–
Reserve Bank of Australia	24 Sep 08	\$30 bn	Yes	1M, 3M
Sveriges Riksbank	24 Sep 08	\$30 bn	Yes	1M, 3M
National Bank of Denmark	24 Sep 08	\$15 bn	Yes	1M, 3M
Central Bank of Norway	24 Sep 08	\$15 bn	Yes	1M, 3M
Reserve Bank of New Zealand	28 Oct 08	\$15 bn		–
Central Bank of Brazil	29 Oct 08	\$30 bn		–
Bank of Mexico	29 Oct 08	\$30 bn		–
Bank of Korea	29 Oct 08	\$30 bn		–
Monetary Authority of Singapore	29 Oct 08	\$30 bn		–
Swiss National Bank providing CHF:				
European Central Bank	15 Oct 08	–	Yes	FX swaps; 1W, 3M
National Bank of Poland	07 Nov 08	–	Yes	FX swaps; 1W, 3M
ECB providing EUR:				
Magyar Nemzeti Bank	16 Oct 08	€5 bn ³	–	O/N FX swap ⁴
National Bank of Denmark	27 Oct 08	€12 bn	Yes	1M, 3M ⁵
National Bank of Poland	21 Nov 08	€10 bn ³	–	–
Nordic central banks providing EUR:				
Central Bank of Iceland	16 May 08	€1.5 bn	Yes	–

¹ Information as of 21 November 2008; refer to swap lines, unless otherwise indicated; – indicates not specified. ² Refer to operations for distributing foreign currency to counterparties (not the inter-central bank transactions). Central banks may have other foreign currency-supplying facilities that draw on existing foreign reserves. Repo or collateralised loans, unless otherwise indicated. 1M = one-month; 3M = three-month; 1W = one-week; O/N = overnight. ³ Based on repo agreement. ⁴ A standing facility was announced but its usage is confidential. ⁵ A three-month auction is planned for 10 December 2008.

Source: Central banks.

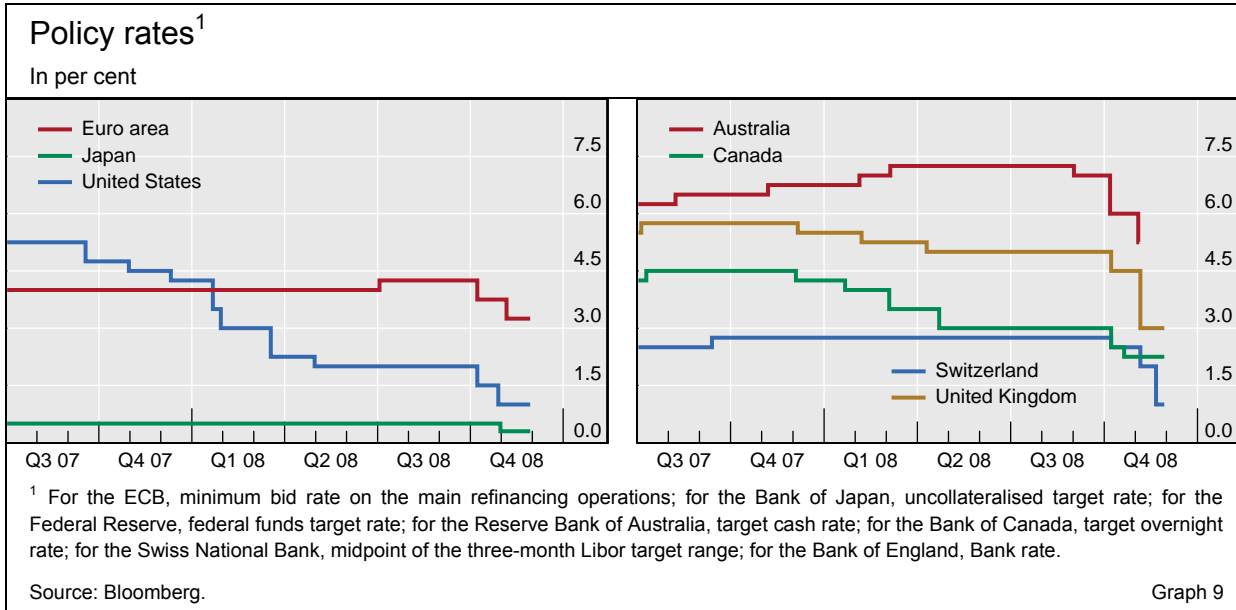


In the United Kingdom, the authorities announced comprehensive measures to recapitalise UK banks, to provide short-term liquidity and to ensure the availability of sufficient medium-term funding for the banking system through guarantees for new unsecured senior bank debt. Yet, despite the increased pace of government intervention, financial market turmoil continued, with credit and stock markets suffering losses on a broad scale into October. The universal scope of the sell-off was particularly apparent from broader global equity indices, which experienced record losses in late September and early October. While the S&P 500 dropped about 25% between 22 September and 10 October, the MSCI World index plummeted more than 28% over the same period. Emerging market equities declined by similar amounts, losing 24% in local currency terms (Graph 8, centre panel); selling pressures were most intense for countries with large current account deficits and relatively high private sector reliance on foreign currency borrowing. Money markets also continued to show signs of extreme dislocation, with Libor-OIS spreads setting new records on a daily basis (Graph 7, left-hand panel).

... stronger deposit guarantees ...

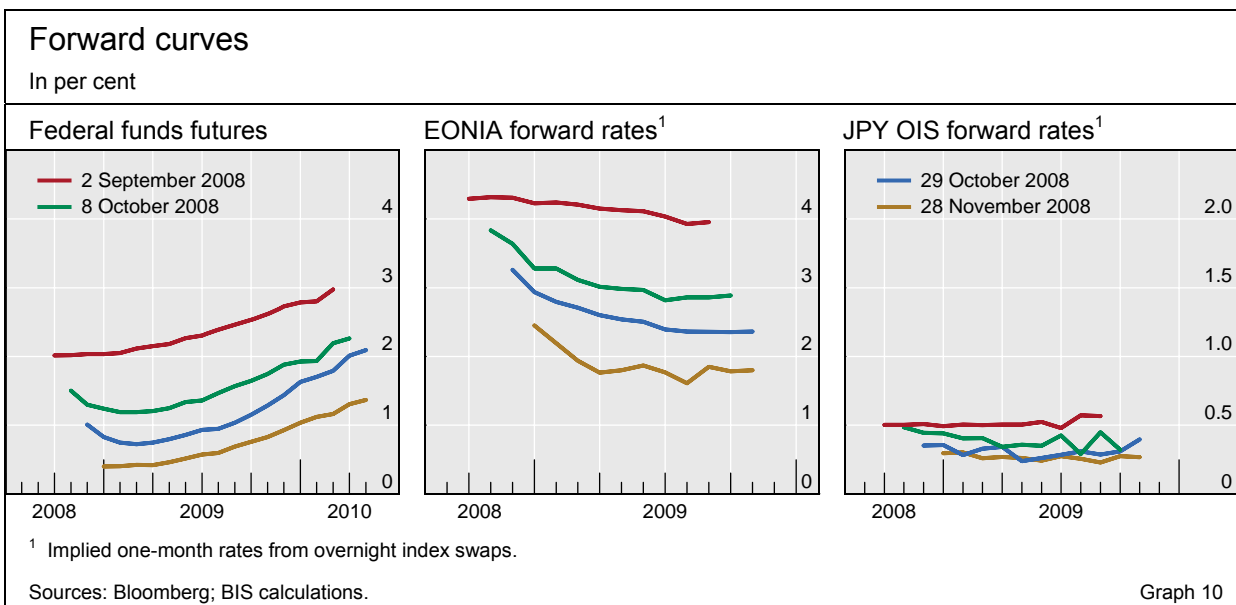
At this point, uncoordinated policy actions by national authorities no longer appeared to be sufficient. On 8 October, the first coordinated international policy response aimed at arresting the deepening crisis of confidence came in the form of an unprecedented round of 50 basis point policy rate cuts by six major central banks, including the Bank of England, the ECB and the Federal Reserve (Graph 9). Futures-based indicators showed that the move was immediately reflected in monetary policy expectations, particularly in Europe (Graph 10).

... globally coordinated rate cuts ...



... and system-wide bank recapitalisations ...

Efforts towards implementing more system-wide, coordinated policy measures continued in the following days. One example was the joint announcement on 13 October by the Federal Reserve, the ECB, the Bank of England and the Swiss National Bank that they would supply US dollar funding at maturities of seven, 24 and 84 days at fixed rates for full allotment to further ease tensions in the money market. Simultaneously, existing swap lines between the Federal Reserve and the other major central banks were increased to accommodate whatever quantity of US dollar funding would be demanded. On the same day, the euro area member countries made unprecedented coordinated announcements of guarantees and equity injections aimed at restarting interbank lending and at replenishing banks' capital positions. This was followed by notice from the US Treasury on 14 October that it would use \$250 billion of the previously legislated rescue package to recapitalise major banks.



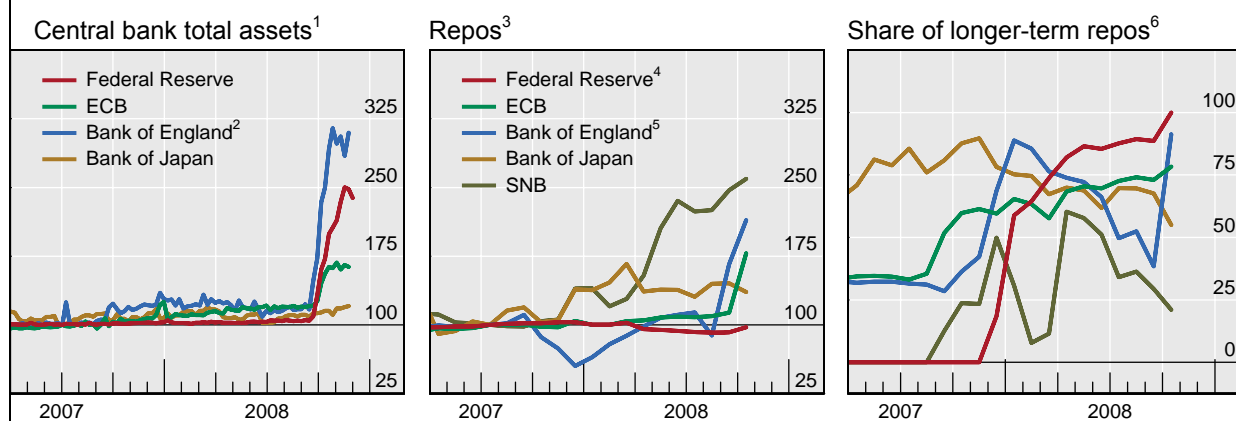
Box 4: Central bank balance sheets

François-Louis Michaud and Gert Schnabel

Central banks in major advanced economies have taken a wide range of actions to address the tensions in the interbank and money markets since August 2007. As a result the size, composition and risk profile of their balance sheets have changed substantially. Major central banks have provided more term funding to a wider range of institutions and against wider collateral than in the past. In some cases, they stepped in to provide direct lending to distressed institutions and took other exceptional measures to improve funding conditions in credit markets. This box outlines how these actions have affected central bank balance sheets.

During the initial stages of the turmoil, until mid-September 2008, central bank measures did not lead to a significant expansion of the size of their balance sheets. However, there was a major shift in the composition of their assets, as central banks conducted, in general, more frequent and longer-term liquidity-providing operations than in the past (Graph A). In some cases, they also broadened the range of eligible collateral.

Central bank assets and open market operations



¹ End-Q2 2007 = 100; weekly data. ² Adjusted by BIS for estimates of items in the course of settlement related to unlimited dollar operations. ³ Repurchase agreements (and term auction credit (TAF) for the Fed) including foreign currency auctions; amounts outstanding; monthly averages, June 2007 = 100. ⁴ Sum of the amount outstanding of repurchase agreements, TAF and US Treasury securities held in the Fed's portfolio. ⁵ Decline from August to December offsets supply of reserves to the market via lending to Northern Rock (NR). The subsequent increase offsets the drain of reserves brought about as mainly the UK government, but also NR, repaid borrowing from the Bank of England. ⁶ Outstanding repos (and TAF for the Fed) including foreign currency auctions of 28 days and beyond as percentage of total outstanding repos (and TAF for the Fed); monthly averages.

Source: Central banks.

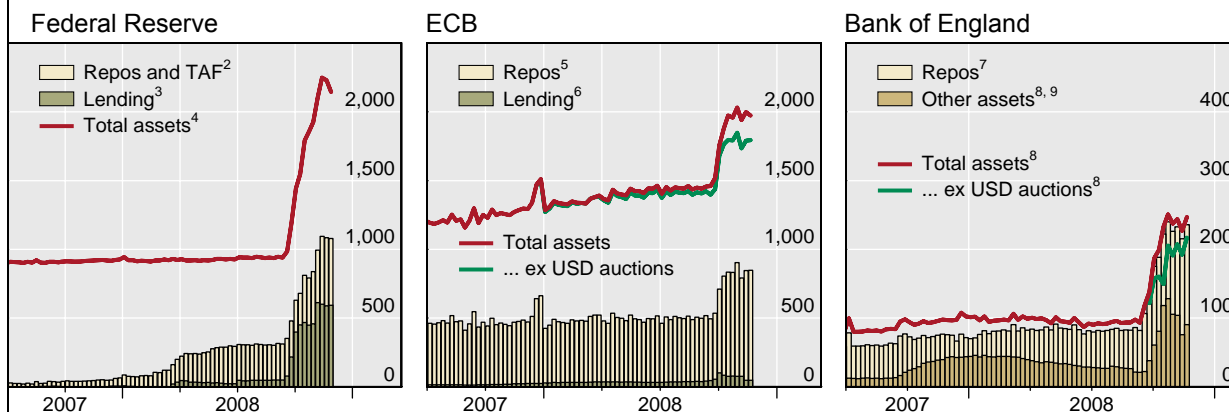
Graph A

In the United States, the Federal Reserve (Fed) lengthened the maturity of its refinancing operations. Their size also increased, but this was offset by the shrinking of its portfolio of Treasury securities. In addition, an increasing share of the latter was lent to primary dealers against a wide range of less liquid securities to help liquefy their balance sheets via the Fed's Term Securities Lending Facility (with no net impact on bank reserves or on the size of the central bank balance sheet). Similarly, the Bank of England (BoE) allowed banks to swap less liquid securities against more liquid ones under its Special Liquidity Scheme. The BoE, European Central Bank (ECB) and Swiss National Bank (SNB) substituted longer-term open market operations (OMOs) for shorter-term operations. While the ECB and SNB established swap lines with the Fed to distribute dollar liquidity to European banks, the amounts involved were relatively limited, and there was little or no use of central bank standing lending facilities.

After the failure of Lehman Brothers, the balance sheets of several major central banks expanded sharply, reflecting their growing intermediation role in money markets. The assets of the Fed and the BoE more than doubled in a matter of weeks, while those of the ECB and the SNB increased by more than 30%. In the Fed's case, this reflected direct lending to banks and dealers through existing and new lending facilities, including those providing indirect lending to money market funds and purchasing commercial paper through special purpose vehicles, and drawings by foreign central banks on dollar swap lines. In Europe, there was also some increase, albeit less marked, in the use of central banks' standing facilities. Most of the growth of central banks' balance

sheets reflected higher net amounts of domestic and dollar liquidity-providing OMOs, representing mostly term funding (Graph B). More auctions were also conducted at a fixed rate with full allotment. The maximum amount of dollar swap lines and related dollar liquidity-providing transactions was significantly increased (and subsequently made unlimited). The US dollar swap lines of the Fed with the ECB, BoE and SNB were increased by more than \$300 billion between end-August and end-September; US dollar lending of these central banks increased by about half that amount over the same period.

Central bank open market operations and lending¹



¹ In billions of national currency units. ² Repurchase agreements and term auction credit (TAF). ³ Primary discount credit, primary dealer credit facility, Maiden Lane (Bear Stearns), AIG, commercial paper and money market mutual fund support measures. ⁴ Total factors supplying reserve funds. ⁵ Main refinancing, long-term refinancing and fine-tuning operations in euros. ⁶ Marginal lending and other claims in euros on euro area credit institutions. ⁷ Short and long-term reverse sterling repos. ⁸ Adjusted by BIS for estimates of items in the course of settlement related to unlimited dollar operations. ⁹ Includes US dollar lending and lending to UK deposit protection.

Source: Central banks.

Graph B

The corresponding growth of central bank liabilities took various forms. There was often a rise in bank reserve balances with the central bank. The ECB saw a sharp increase in the use of its deposit facility. In addition, several central banks took steps to manage their liabilities more flexibly. In the United States, the Treasury issued supplementary bills and held the proceeds at the Fed (nearly \$500 billion). Importantly, the Fed began to pay interest on bank reserves – currently at the average (lowest) FOMC target rate during the reserve maintenance period for required (excess) reserves – making it easier to expand its balance sheet at positive interest rates. The BoE and ECB narrowed the corridor between the rates of their lending and deposit facilities from 200 to 50 and 100 basis points, respectively. The ECB also announced that it might raise one-week fixed-term deposits. Several central banks started to issue their own bills (the BoE, Riksbank and SNB).

State guarantees for bank debt may slow the growth and increase in riskiness of central bank sheets. To the extent that government-guaranteed facilities help to stabilise markets, they can make private liquidity providers less reluctant to lend to banks. This would allow central banks to gradually scale back their role in bank funding. And as central banks start accepting government-guaranteed debt as collateral, the risk profile of their balance sheets may also improve.

The greatly increased level of central bank intermediation is often viewed as a temporary substitute for impaired private financial intermediation. However, interbank lending has not resumed, and money markets remain dysfunctional despite increased central bank intermediation and state guarantees. This may of course reflect banks' continued balance sheet and capital constraints. An additional factor may be the differences in state guarantees across countries and their gradual implementation. Banks' funding liquidity management may also be evolving, and banks may wish to rely less on wholesale funding markets. Finally, increased central bank intermediation may in some cases weaken banks' incentives to resume their intermediation function. For instance, borrowing from the central bank at close to the policy rate with no counterparty risk may arguably reduce banks' incentives to raise funds from market sources. And narrow spreads between central bank target rates and the rates paid on excess balances also discourage banks from lending to other banks. It is unclear how much, and for how long, central banks may need to expand their balance sheets.

With the flurry of unprecedented policy initiatives taken across countries up to mid-October increasingly adding up to a joint approach, market prices finally responded. As potentially large amounts of financial institutions' senior liabilities had effectively become quasi-government debt, financial sector spreads rallied back from the peaks reached earlier during the period (Graph 2, left-hand panel). The recovery in financial credit initially helped to drag broader credit spread indices lower (Graph 3, left-hand and centre panels). However, markets remained under strain from ongoing portfolio liquidations by leveraged investors suffering from margin calls and redemptions.

... prevent complete collapse of confidence

Signs of gradually easing pressures were also evident in other markets. The three-month US dollar Libor-OIS spread peaked at 364 basis points on 10 October and maintained a steady downward trend into November, with spreads reaching around 170 basis points. Similar pricing patterns were seen in euro and sterling Libor-OIS spreads, suggesting that interbank markets were finally beginning to stabilise (Graph 7, left-hand panel). In the meantime, major equity markets were showing at least temporary signs of relief (Graph 4, left-hand and centre panels), with the Dow Jones Industrial Average rising 11% on 13 October alone, its largest one-day percentage increase since 1933. Other equity indices also rallied back from their previous lows, as did emerging market equities and bonds (Graph 8, left-hand and centre panels).

Signs of relief prove temporary

At the same time, unintended side effects of recent policy initiatives were starting to show up in markets such as those for US agency securities. After an initial decline, spreads on agency debt and MBS soared even beyond the peaks experienced prior to the government takeover of Fannie Mae and Freddie Mac in early September (Graph 1, right-hand panel). Given newly announced FDIC guarantees for eligible unsecured bank debt issued before 30 June 2009, investors had started to anticipate a potentially sizeable new asset class of AAA-rated bank debt that would compete directly with agency paper. Uncertainties about the exact nature of the government guarantee for the agencies' longer-maturity debt and ongoing investment fund redemption sales put further upward pressure on agency spreads. Similar side effects were evident in collateralised lending markets, especially those for repurchase agreements (see the special feature by P Hördahl and M King on pages 37–53 for a discussion).

The scope and magnitude of the bank rescue packages also meant that significant risks had been transferred onto government balance sheets. This was particularly apparent in the market for CDS referencing sovereigns involved either in large individual bank rescues or in broad-based support packages for the financial sector, including the United States. While such CDS were thinly traded prior to the announced rescue packages, spreads widened suddenly on increased demand for credit protection, while corresponding financial sector spreads tightened (Graph 2, left-hand panel).

Recession fears take centre stage

By mid-October, accumulating evidence from macroeconomic data releases was starting to overshadow the immediate effects of government initiatives

Recession fears ...

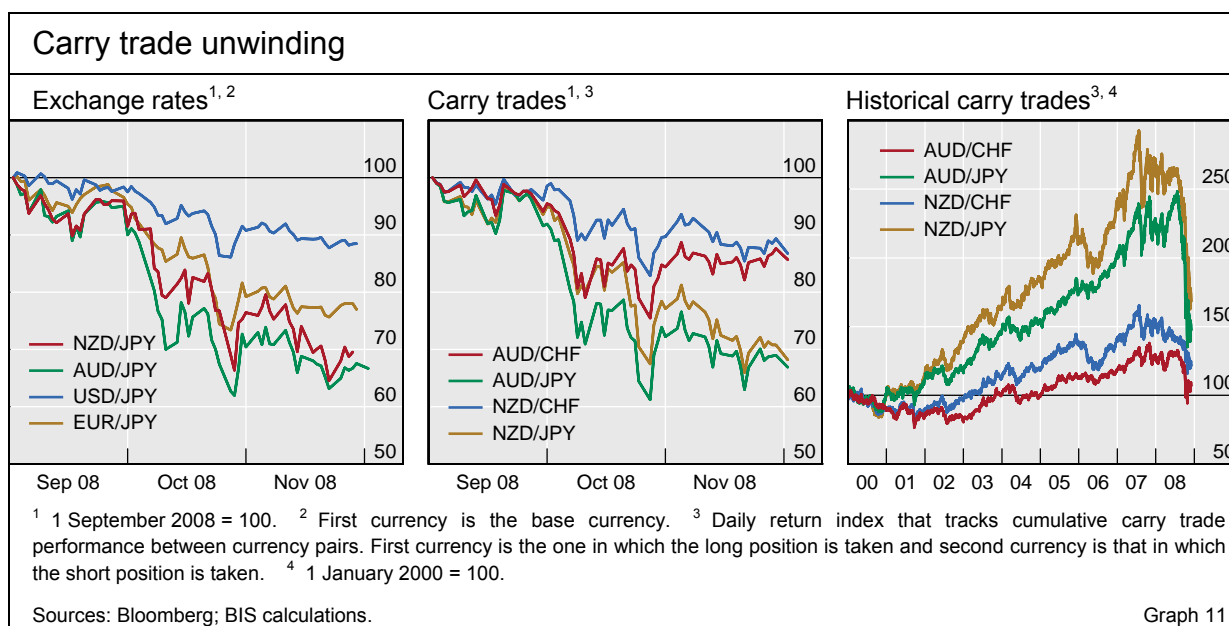
... fed by negative macroeconomic news ...

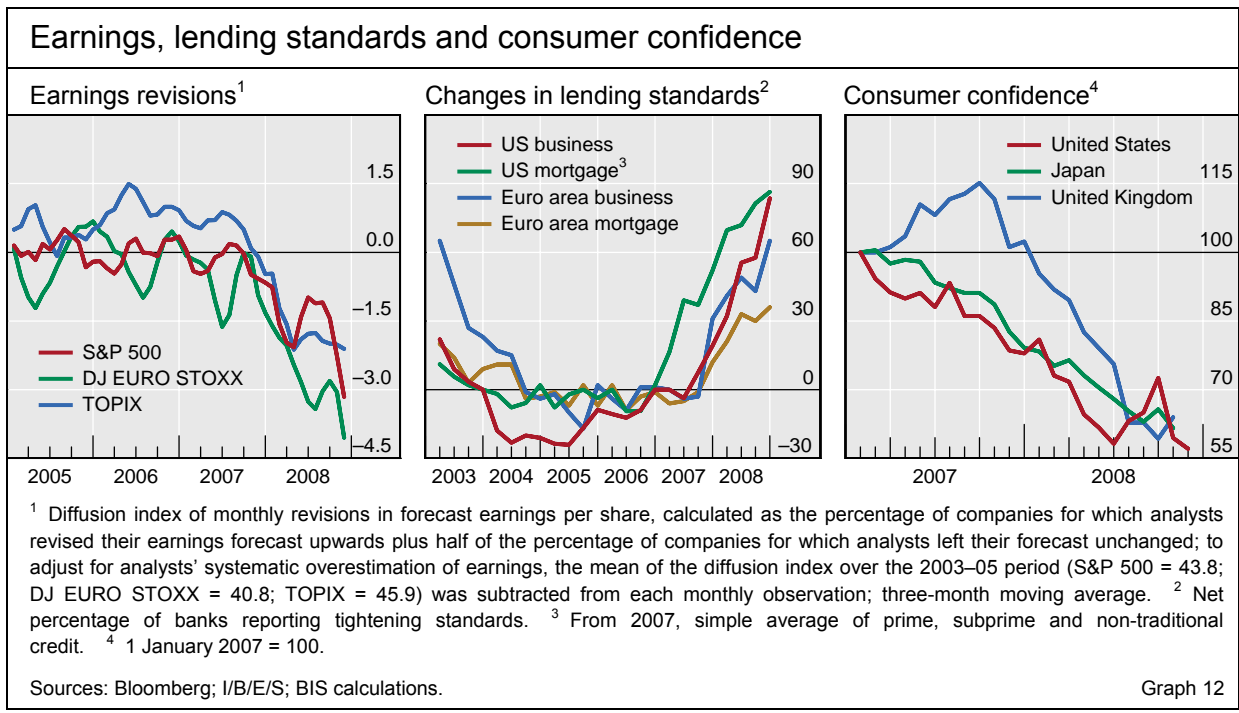
across markets. Reports on economic activity confirmed that numerous major economies had officially moved into recession or were about to do so. Thus, while the combined efforts of central banks and governments appeared to have successfully arrested the global crisis of confidence, gains across most asset classes turned out to be short-lived. The main exception was short-term funding markets, where conditions continued to gradually recover, with US money market fund assets stabilising and Libor-OIS spreads declining, though still at levels higher than those before the credit crisis.

... drive credit spreads up ...

Credit markets quickly refocused on expectations of an approaching global recession and the associated increase in default-related losses. Contracting bond issuance and depressed bank lending were consistent with growing concerns about the lack of availability of credit for households and non-financial companies. Following weak macroeconomic data releases for the United States on 16 October, credit spreads resumed their earlier upward drift. To be sure, the widening of credit spreads at times reflected policy uncertainty in addition to recession fears. The mid-November announcement that TARP funds previously meant for the purchase of troubled assets were being reallocated in support of the consumer finance sector – where lending activity had increasingly been impaired by collapsing securitisation volumes – pushed CDS spreads to new highs, reflecting expectations that the anticipated asset purchases would not materialise (Graph 3, centre and right-hand panels). Signs of recovering credit spreads emerged only in late November, following the announcement of a support package for Citigroup and of measures aimed at supporting the markets for asset-backed securities and US agency debt. Stresses remained, however, as suggested by the continued widening of spreads in troubled sectors, such as commercial real estate.

At the same time, the unwinding of currency carry trades, which had begun after the Lehman event, gained new momentum in the wake of elevated market volatilities and the investor retreat from risky assets (Graph 11, left-hand and centre panels). Lower-yielding currencies appreciated and carry





trade returns turned strongly negative, eroding some six years' worth of accumulated gains (Graph 11, right-hand panel).

Equity markets also reflected the fact that recession fears came into focus in late October and November: declines in global equity markets over the quarter exceeded those during any of the crises since the 1930s. Major indices fell sharply on almost universally negative earnings-related news, tightening lending standards and rapid declines in consumer confidence (Graph 12). By end-November, despite additional monetary easing by several central banks and a late-month recovery, global stock markets had fallen by some 35% from their end-August levels. As a result, price/earnings ratios for many major indices were down to levels not seen for at least a decade.

... and equity markets down

The prices of emerging market assets continued to adjust to a combination of collapsing exports, more limited private sector access to funding and rapidly declining commodity prices. Signs of indiscriminate asset disposals emerged in mid-October, as plummeting risk appetite and concerns about the availability of trade finance increasingly translated into large-scale redemption flows out of emerging market assets. Pressures came to a head in the week of 21 October, when speculation that the authorities in Argentina might nationalise the public pension system caused concerns about political risk to soar. This occurred despite efforts by emerging market central banks to enhance their domestic and foreign currency lending operations and the announcement of full or partial guarantees of bank deposits in several economies.

As investors retrench ...

... and concerns about political risk soar ...

Emerging market sentiment temporarily recovered in late October and early November, but was weighed down by recession fears during the remainder of the period. Reaching their highest levels since 2002, EMBIG spreads widened to a peak near 891 basis points on 24 October, before tightening by about 276 basis points into early November. Emerging equity

... emerging markets assets sell off

markets also extended their previous declines, reaching new lows on 27 October. Conditions stabilised only after the announcement of a \$25 billion support package for Hungary on 28 October and news of dollar swap lines between the Federal Reserve and the monetary authorities in Brazil, Korea, Mexico and Singapore the next day (Graph 8, left-hand and centre panels). By end-November, emerging credit and equity markets had recovered somewhat from their late October levels, mirroring the performance of their industrialised country counterparts. Nevertheless, reflecting the heavy losses experienced since August, price/earnings multiples in emerging market economies generally adjusted more sharply than those in the United States and other major markets, with relative valuations across countries broadly back in line with historical discounts relative to the industrialised world (Graph 8, right-hand panel).

Bond yields
decline ...

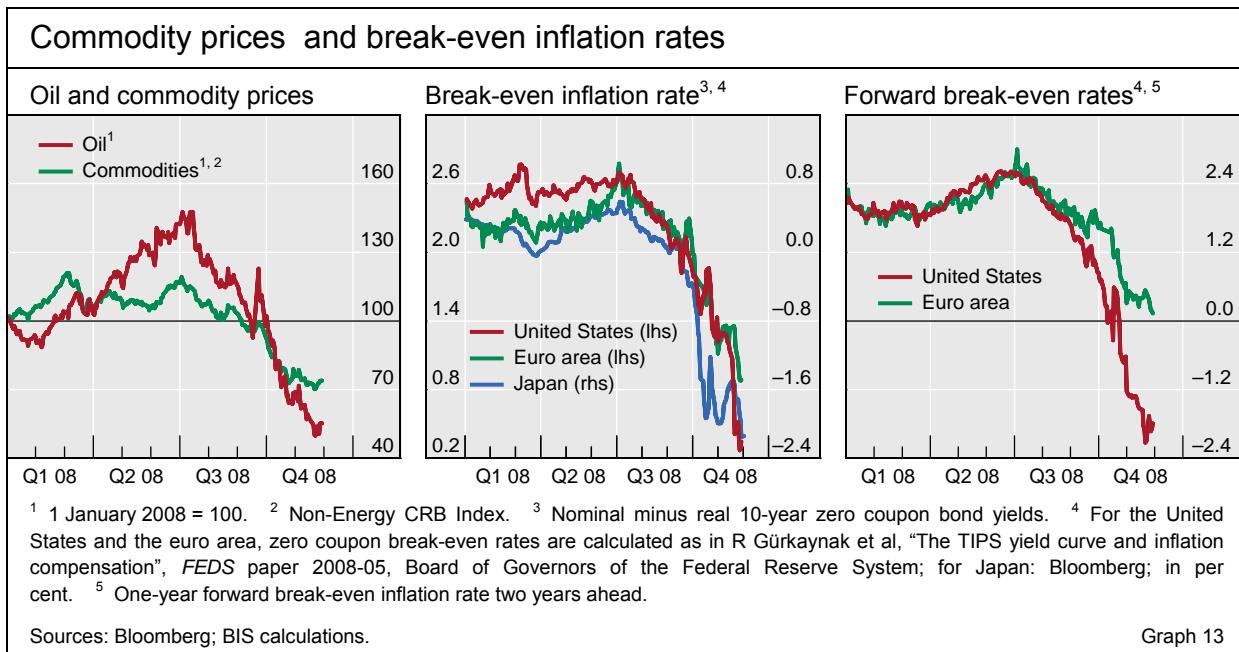
At the same time, recession fears put shorter-term yields squarely on a downward trajectory. The lowering of policy rates as well as a flight to safety pushed two-year yields dramatically lower in both the United States and the euro area, to 0.96% and 2.1%, respectively, by end-November. Likewise, expectations about the path of near-term policy rates were also revised downwards. As a result, federal funds futures prices signalled expectations of low and broadly steady policy rates in the United States for much of 2009, consistent with depressed to negative growth over the coming quarters (Graph 10, left-hand panel). In the euro area, EONIA swap prices pointed to a further lowering of policy rates by the ECB over the next 12 months (Graph 10, centre panel), reflecting in part the greater leeway for additional rate adjustments compared to the United States. In Japan, the policy rate was adjusted downwards by 20 basis points on 31 October, reaching a level of 30 basis points for the first time since March 2001. Japanese forward rates, in turn, suggested expectations of unchanged policy rates for most of 2009.

... on lower policy
rates ...

... expectations of
lower inflation ...

In this environment, break-even inflation rates derived from the yields of nominal and inflation-indexed bonds fell significantly across all maturities. The declines were particularly pronounced in the United States, where the 10-year break-even rate dropped by 1.9 percentage points between end-August and end-November, although substantial declines were seen in the euro area and Japan as well (Graph 13, centre panel). Even sharper drops took place at the short end of the maturity spectrum, with, for example, US implied one-year forward break-even rates two years ahead plunging by 3.5 percentage points during this period to reach levels deep inside negative territory (Graph 13, right-hand panel). With break-even inflation rates typically seen as indicators of investors' inflation expectations, the observed declines appeared to be in line with perceptions of rapidly easing price pressures amid accumulating signs of a broad-based global slowdown. Moreover, the declines that took place at the short end of the break-even curve largely reflected developments in both oil and commodity prices, which declined by over 50% and 30%, respectively, between end-August and end-November (Graph 13, left-hand panel).

... falling commodity
prices ...



Nevertheless, another important factor behind the sharp drops in break-even rates is likely to have been rising liquidity premia and sell-side pressures from leveraged investors unwinding their positions. Consistent with this, much of the decline in US break-even rates that took place in September and October was due to real bond yields rising faster than nominal yields, suggesting that more technical factors may have played a significant role in driving the dynamics of break-even rates during this period. However, by early November, real yields had stabilised while nominal yields again fell as recession fears and concerns about the health of the financial sector intensified, leading to renewed downward pressure on break-even rates.

... as well as
recession fears

Highlights of international banking and financial market activity¹

The BIS, in cooperation with central banks and monetary authorities worldwide, compiles and disseminates several datasets on activity in international banking and financial markets. The latest available data on the international banking market refer to the second quarter of 2008. The discussion on over-the-counter derivatives refers to the first half of 2008, and that on international debt securities and exchange-traded derivatives draws on data for the third quarter of 2008.

The international banking market

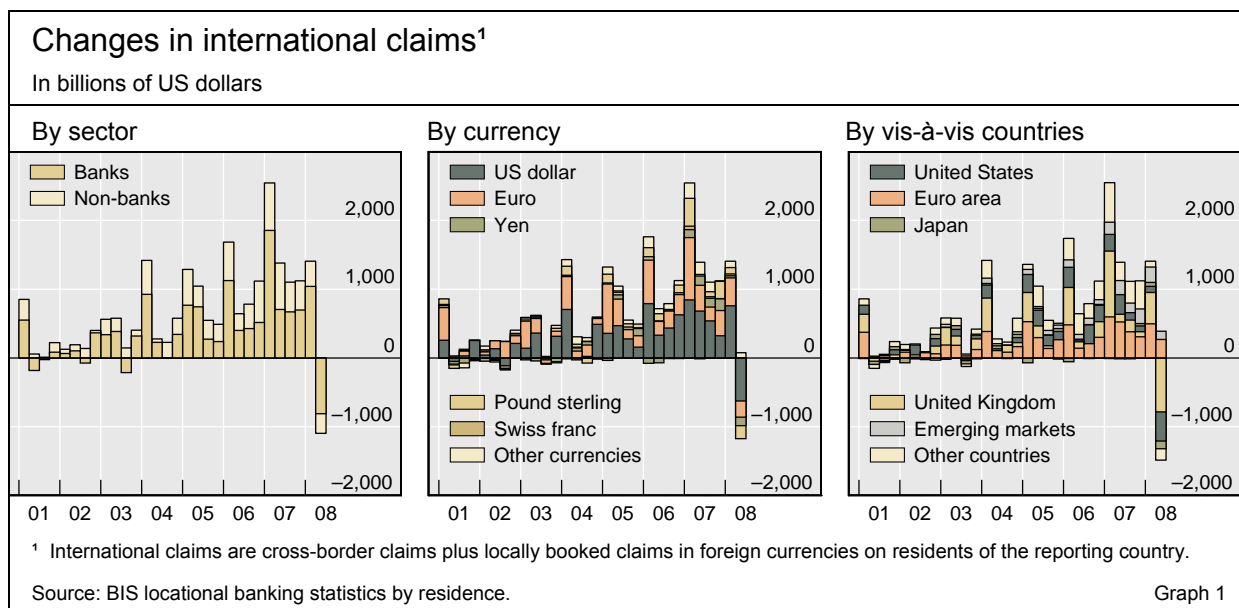
Outstanding claims in the international banking market contracted sharply during the second quarter of 2008. BIS reporting banks' international claims² fell by an unprecedented \$1.1 trillion (Graph 1, centre panel), with most currency segments registering sizeable declines. While a significant decrease in interbank claims (–\$812 billion) accounted for most of the overall decline (Graph 1, left-hand panel), international claims on non-banks also fell (for the first time since 1998), mainly vis-à-vis the United States, the United Kingdom and Japan. At the same time, residents of emerging markets and many central banks around the world reduced their placements of funds with BIS reporting banks (Graph 1, right-hand panel).

Interbank activity contracts

Banks throughout the reporting area continued to write down and unwind their international positions, with banks in the United Kingdom reporting the largest decline in outstanding claims (81% of the overall decline). Graph 2 plots UK

¹ Queries concerning the banking statistics should be addressed to Patrick McGuire and Blaise Gadanecz, queries concerning over-the-counter derivatives statistics to Jacob Gyntelberg, and queries concerning international debt securities and exchange-traded derivatives statistics to Naohiko Baba. The authors gratefully acknowledge the research assistance provided by Carlos Mallo, Denis Pêtre and Swapan-Kumar Pradhan.

² In the BIS locational banking statistics by residence, international claims (liabilities) are cross-border claims (liabilities) plus locally booked claims (liabilities) in foreign currencies vis-à-vis residents of the reporting country.



resident banks' cumulative *net* (assets minus liabilities) change in international positions vis-à-vis banks (solid lines) and non-banks (dashed lines), broken down by currency (left-hand panel) and by residence of the counterparty (right-hand panel). Since 2000, these banks have built up large net claims on non-bank borrowers, financed by similarly large net liabilities vis-à-vis the banking sector (which include borrowing from central banks). These net positions have contracted since the start of the crisis in mid-2007, with particularly large movements in the second quarter of 2008. Net borrowing from other banks (including inter-office borrowing) shrank by \$352 billion (left-hand panel, solid red line), stemming from a \$545 billion decline in gross claims and an even larger one (–\$897 billion) in gross liabilities. At the same time, net claims on non-banks contracted by \$307 billion (left-hand panel, dashed red line), driven by a reduction of \$339 billion in gross claims, primarily vis-à-vis non-banks in the United States (right-hand panel, dashed green line).

The contraction in interbank borrowing was especially pronounced in the US dollar segment of the market, although interbank borrowing in other currencies also fell sharply. Across all reporting countries, US dollar interbank liabilities dropped by \$693 billion. Banks in the United Kingdom registered a \$423 billion decline, roughly half of this vis-à-vis banks in the United States. Reduced liabilities to banks in offshore financial centres, Asia-Pacific, Africa and the Middle East and to other banks in the United Kingdom made up much of the difference. Banks in Switzerland and in many offshore financial centres also reported significant decreases in US dollar interbank liabilities. In contrast, banks in the euro area reported a \$76 billion increase, primarily vis-à-vis banks in the United States.

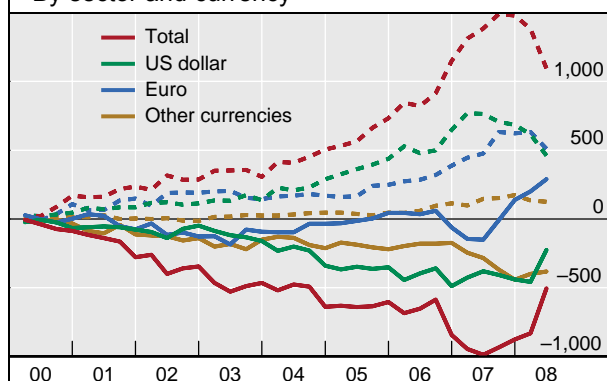
Lending to banks in the United Kingdom contracts ...

... particularly in US dollars

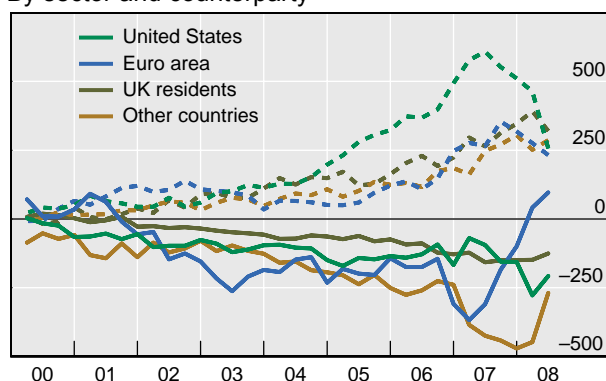
Cumulative net claims of banks located in the United Kingdom¹

In billions of US dollars

By sector and currency



By sector and counterparty



¹ Thick lines refer to cumulative net interbank claims and dashed lines to cumulative net claims on non-banks, booked by banks located in the United Kingdom. Net claims are claims minus liabilities, and include reporting banks' cross-border positions in all currencies plus local positions vis-à-vis UK residents in foreign currencies, expressed at constant end-Q2 2008 exchange rates. These flows are estimated by combining data from several reporting countries, which helps in identifying the residence of the holders of banks' debt security liabilities.

Source: BIS locational banking statistics by residence.

Graph 2

The BIS consolidated banking statistics,³ which track reporting banks' foreign interbank exposures excluding inter-office activity, shed light on which banking systems experienced large moves during the second quarter of 2008 (Graph 3). Across all banking systems, (gross) consolidated interbank claims dropped by \$298 billion in that quarter, the first outright decrease since 2005. This was mainly caused by reduced interbank positions reported by UK banks (-\$171 billion) and French banks (-\$102 billion), especially vis-à-vis US, Dutch, German and UK banks. US banks, in contrast, reported reductions of only \$9 billion.

Over the past few quarters, these interbank exposures have declined relative to banks' capital bases (Graph 4, right-hand panel). While these reductions, most pronounced in the case of Dutch banks, primarily reflected the contraction in the interbank claims described above, they were also the result of increases in Tier 1 capital levels reported by most banking systems.

First decline in claims on non-banks in a decade

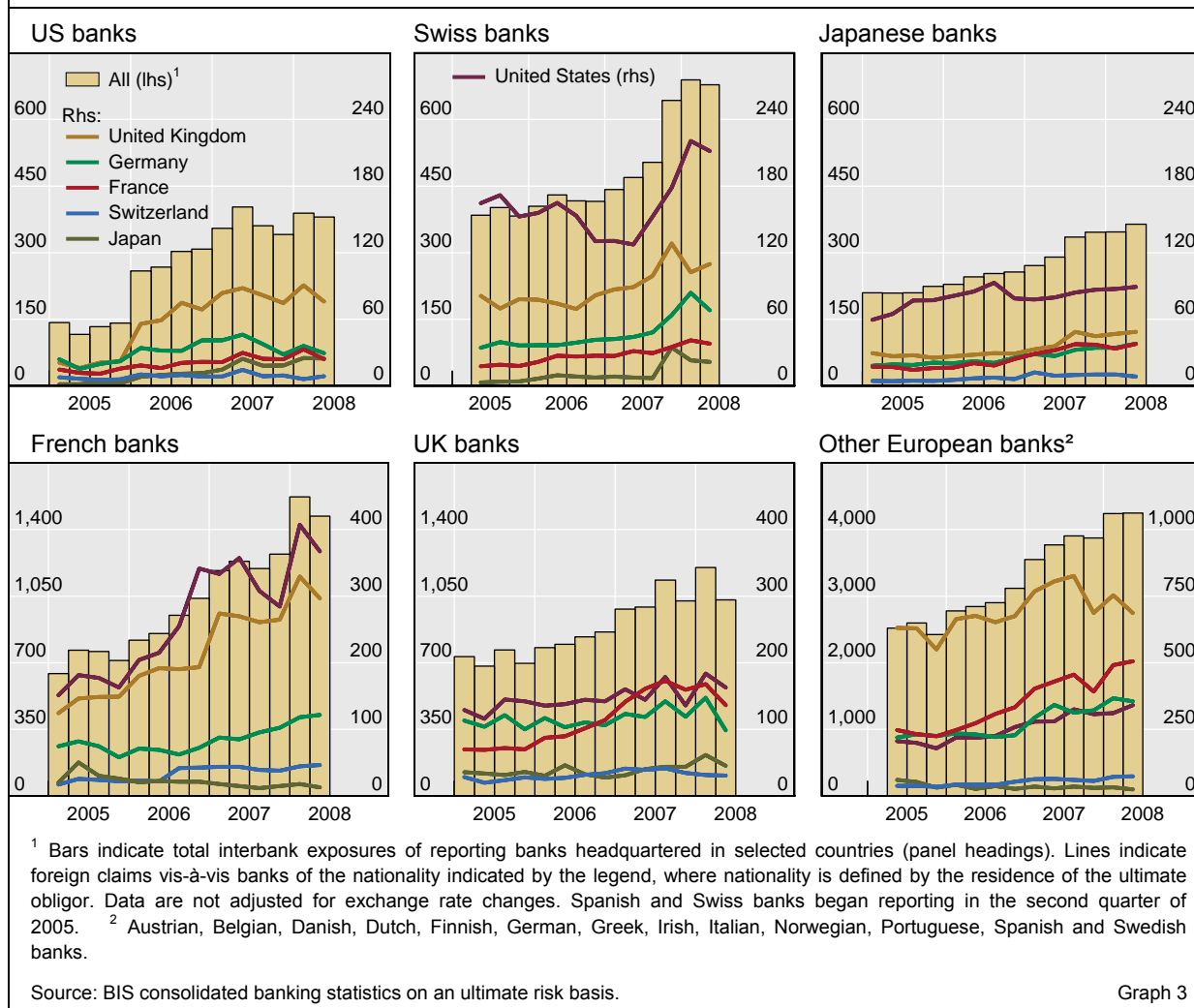
BIS reporting banks' international claims on non-banks contracted in the second quarter of 2008 for the first time since 1998.⁴ While a decrease in

³ The BIS consolidated banking statistics (ultimate risk basis) track individual banking systems' foreign claims (excluding inter-office claims). The ultimate risk reporting concept, combined with the sectoral breakdown, provides a rough estimate of bilateral interbank exposures of national banking systems. For example, on an ultimate risk basis, interbank claims reported by the United States vis-à-vis the United Kingdom provide an estimate of US banks' foreign claims on UK banks (as opposed to US banks' claims on banks located in the United Kingdom, as in the BIS consolidated statistics on an immediate borrower basis).

⁴ Reductions, totalling \$286 billion, were reported mainly by banks located in the United Kingdom (-\$339 billion), the United States (-\$78 billion), Japan and the Cayman Islands (-\$36 billion each). Meanwhile, banks in the euro area registered a \$125 billion expansion of their cross-border claims on non-banks, primarily driven by intra-euro area activity.

Interbank exposures of selected banking systems

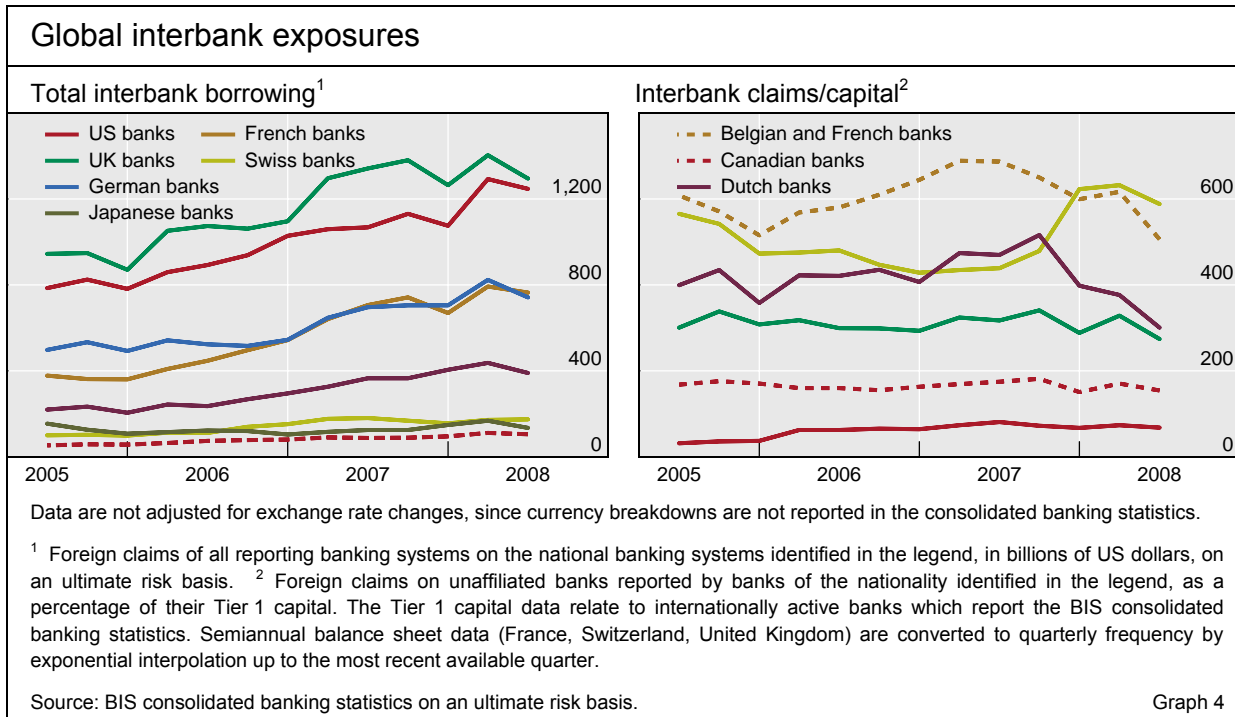
By nationality, in billions of US dollars



loans accounted for almost 80% of the \$286 billion overall decline, decreases in debt security claims also contributed (-\$23 billion), reflecting both writedowns and outright sales of securities.⁵ Claims on non-banks in the United States fell the most (-\$191 billion), followed by the United Kingdom (-\$144 billion), the Cayman Islands (-\$62 billion) and Japan (-\$55 billion). Much of this was US dollar-denominated (\$229 billion), although euro- and yen-denominated credit declined as well.⁶

⁵ Reductions in outstanding claim stocks may reflect a combination of factors, including writedowns, the extension or drawing-down of credit lines, the movement of affiliated structured investment vehicles onto the balance sheet, and outright cutbacks in lending.

⁶ Data from Dealogic on signings of international syndicated loans also suggest a slowdown in lending to non-banks in the major economies. New signings of loan facilities granted to non-banks fell to \$462 billion in the second quarter of 2008, and to \$401 billion in the third quarter, compared with a peak of \$768 billion in the second quarter of 2007. The slowdown in new signings was especially pronounced for residents of the United States, the United Kingdom and the euro area. The non-bank financial sector as well as industries exhibiting a strong sensitivity to the economic cycle were particularly affected. The ratio of uncompleted (announced but unsigned) facilities to completed ones for non-bank borrowers worldwide rose



The BIS consolidated banking statistics, which track the exposure of national banking systems and have a finer counterparty sectoral breakdown, shed some more light on these moves. Reporting banks' foreign claims on US non-banks fell by \$259 billion in the second quarter of 2008, with the Swiss and UK banking systems registering the largest decreases (–\$72 billion and –\$66 billion, respectively). Across all reporting banks, foreign claims on the US non-bank *public* sector remained stable in absolute terms in the second quarter, at \$666 billion, while foreign claims on the *non-bank private* sector fell by \$253 billion to \$4.3 trillion. As a result, foreign claims on the US non-bank private sector declined to 69% of total foreign claims on the United States, down from a peak of 72% at end-2007.

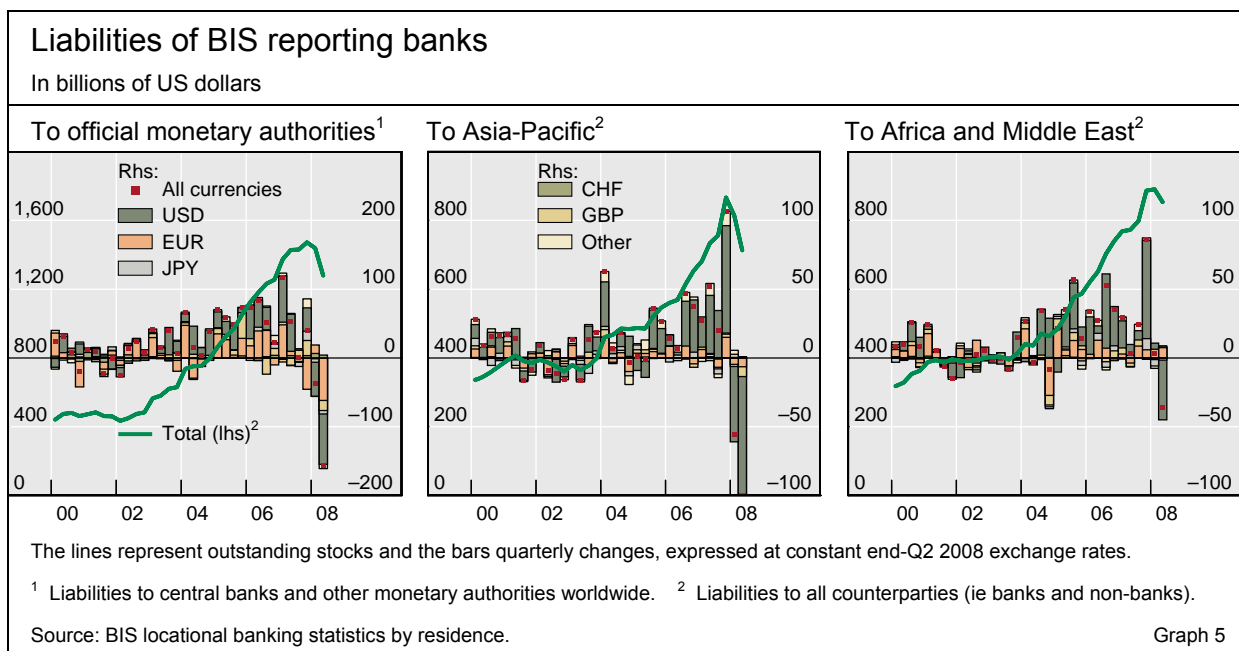
Banks' liabilities come under pressure

Decreases in liabilities to official monetary authorities ...

BIS reporting banks' liabilities vis-à-vis official monetary authorities continued to decline in the second quarter (Graph 5, left-hand panel). Total liabilities to these counterparties fell by a record \$157 billion, with the UK, French and Swiss banking systems registering the largest decreases. US dollar-denominated liabilities dropped by \$73 billion and euro-denominated by \$62 billion. The BIS statistics do not include information on which countries' official monetary authorities accounted for these moves.⁷ However, data on

to 7% in the second quarter (slightly more for facilities related to mergers and acquisitions and to leveraged buyouts), after averaging 5% between 2004 and 2007.

⁷ Banks' positions vis-à-vis official monetary authorities are reported as a memo item in the BIS statistics, and thus are not broken down by the country of residence. Reported liabilities will include deposits placed in reporting banks as part of central bank reserve management, reverse repo positions vis-à-vis reporting banks, and any loans which have arisen in the context of central banks' liquidity enhancement operations. There are some differences in the definition of official monetary authorities across reporting countries. For example, positions



reserve holdings reported by 63 monetary authorities to the IMF provide some information on which central banks were involved. As in the first quarter of 2008, central banks in emerging economies, in particular Russia (−\$42 billion), and some Asian countries (−\$96 billion) reported relatively large reductions in deposits placed in commercial banks in the second quarter.⁸

BIS reporting banks' also registered large declines in liabilities to some emerging market regions in the second quarter of 2008 (Graph 5, centre and right-hand panels).⁹ Liabilities to all sectors in Asia fell by \$100 billion, mainly vis-à-vis China (−\$56 billion), Hong Kong SAR (−\$22 billion), Singapore (−\$21 billion), Chinese Taipei (−\$18 billion) and Korea (−\$14 billion). Most of this was in US dollars, driving down the share of US dollar liabilities to 68% of total liabilities vis-à-vis the region, from 70% in the previous quarter. Banks' liabilities to Africa and the Middle East fell by a record \$36 billion, bringing down the share of US dollar liabilities vis-à-vis that region to 63%, from 65% in the first quarter.

... and to emerging markets

vis-à-vis central governments and other international organisations are included in this sector in the data reported by the United States.

⁸ The largest declines were observed for Hong Kong SAR (−\$18 billion), Japan (−\$17 billion), Korea (−\$16 billion), Malaysia (−\$15 billion) and the Philippines (−\$10 billion). These reductions may also reflect a switch by central banks from unsecured to secured lending (ie reverse repos), which is not included in the SDDS figures used here. Note, in addition, that large reserve-accumulating countries such as China and some Middle East oil producers do not report the SDDS data.

⁹ These may in part reflect the changes in liabilities vis-à-vis official monetary authorities discussed above.

Derivatives markets

Exchange-traded derivatives

Turnover of futures and options decreases ...

The third quarter of 2008 saw a retreat in activity on the international derivatives exchanges. Total turnover based on notional amounts decreased to \$542 trillion from \$600 trillion in the second quarter. Most of the contraction took place in derivatives on short-term interest rates. Turnover declined slightly in derivatives on long-term interest rates. By contrast, it increased in derivatives on stock indices and foreign exchange. Turnover in derivatives on commodities, observable only in terms of the numbers of contracts, dropped for the second consecutive quarter.

... particularly in derivatives on short-term interest rates

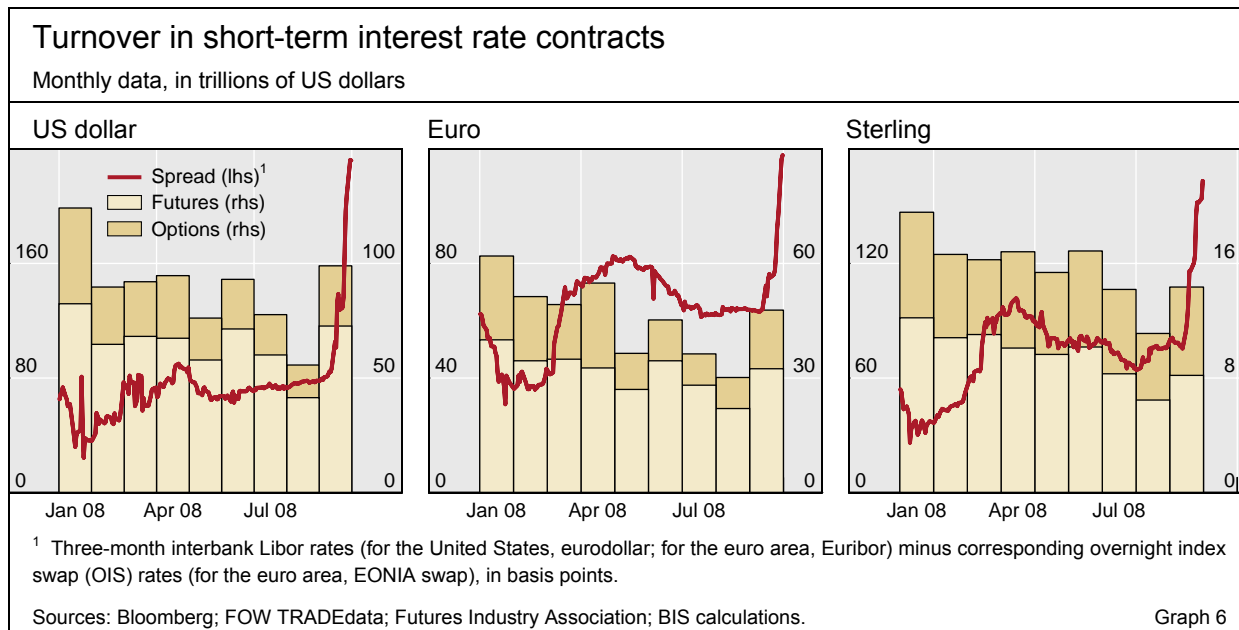
Turnover in derivatives on short-term interest rates decreased to \$407 trillion from \$473 trillion in the previous quarter. The most significant fall was observed in the US dollar segment, followed by the euro and sterling segments (Graph 6). In particular, turnover in futures and options on both three-month eurodollar rates and federal funds rates declined in the third quarter, although monthly data show that turnover in both contracts rebounded in September, amid the increased tensions in financial markets.

Activity in equity derivatives recovered to \$76 trillion from \$67 trillion. By currency of denomination, the largest increase came from US dollar-denominated contracts, followed by Korean won contracts. Conversely, activity in Indian rupee and yen contracts declined slightly.

Turnover in derivatives on foreign exchange rates increased marginally, to \$7.9 trillion from \$7.5 trillion. The increase was attributed mostly to euro-denominated contracts and offset a decline in trading in currencies such as the US dollar and Swiss franc.

Trading in commodity derivatives declines

Trading in commodity derivatives declined in the third quarter. Global turnover in commodity derivatives measured by number of contracts (notional amounts are not available) decreased from 425 million to 410 million. Most of the fall was attributed to agricultural derivatives, occurring largely on the US



exchanges. Turnover in oil-related derivatives went down from 98 million to 92 million contracts amid the significant drop in oil prices, though turnover in the broader category of energy derivatives remained at a high level of 140 million.

OTC derivatives

In November, the BIS released the latest statistics based on positions as at end-June 2008 in the global over-the-counter (OTC) derivatives markets.¹⁰ The notional amounts outstanding of OTC derivatives continued to expand in the first half of 2008. Notional amounts of all types of OTC contracts stood at \$683.7 trillion at the end of June, 15% higher than six months before. While, by volume, credit default swap (CDS) contracts registered their first ever decline, markets for interest rate and FX derivatives, as well equity and commodity derivatives, recorded significant growth.

CDS volumes decline in wake of turmoil

For the first period ever since publication of the statistics began in December 2004, the notional amounts outstanding of CDS contracts saw a 1% decline compared with the notional amounts outstanding at the end of 2007. This compares with an average six-month growth rate for outstanding CDS contracts over the last three years of 45%. The fall was due largely to significantly higher numbers of multilateral terminations of CDS contracts, as a result of the financial turbulence (see box). Despite the decline in outstanding volumes, gross market values, which measure the cost of replacing all existing contracts and are thus a better gauge of market risk than notional amounts, of CDS contracts increased by 58% in the wake of increases in credit and counterparty risk during the turmoil. Gross market values rose for both single- and multi-name contracts.

Growth in the notional amounts outstanding of interest rate derivatives increased in the first half of 2008 after an average rate of growth in the second half of 2007. Notional amounts outstanding of these instruments reached \$458.3 trillion at the end of June 2008, 17% higher than six months previously. Gross market values of OTC interest rate derivatives grew by 29% to \$9.3 trillion, driven primarily by interest rate swaps, which constitute by far the largest market segment. The first half of 2008 also saw robust activity in foreign exchange derivatives, as notional amounts increased by 12% to \$63.0 trillion, while gross market values rose by 25% to \$2.3 trillion.

Robust activity in foreign exchange derivatives ...

Notional amounts outstanding of equity derivatives went up by 20% in the first half of 2008, reversing a 1% decline in the second half of 2007. Notional amounts of OTC equity contracts stood at \$10.2 trillion at the end of June 2008, more than half of which was accounted for by contracts written on European stocks.

Robust activity was also observed in the market for OTC commodity derivatives, with notional amounts outstanding increasing by 56% to reach \$13 trillion at the end of June. This was largely due to strong growth in non-gold contracts, which rose to \$12.6 trillion. Forwards and swaps in these

... and strong increase in commodity derivatives

¹⁰ For a discussion of the methodology of the survey, see the November 2008 Statistical Release, available at www.bis.org/publ/otc_hy0811.htm.

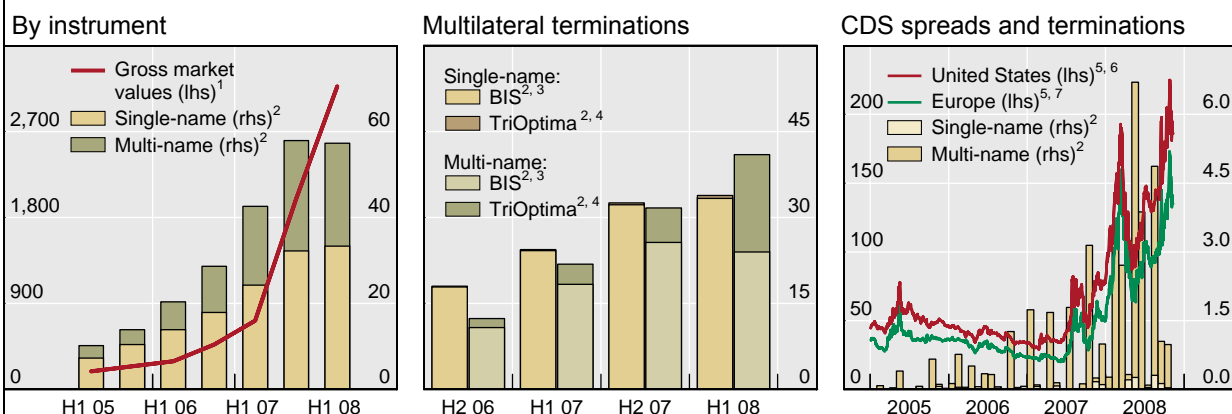
Voluntary terminations of credit default swap contracts

Jacob Gyntelberg and Carlos Mallo

Turmoil in credit markets and money markets in the first half of 2008 led market participants to engage in a significantly higher number of multilateral terminations of credit default swap (CDS) contracts. As a result, notional amounts outstanding of CDS contracts saw a decline, for the first period ever since publication of the statistics began in December 2004, of 1% compared with the notional amounts outstanding at the end of 2007 (Graph A, left-hand panel).

The decline to a large extent reflects unusually large volumes of voluntary multilateral terminations, or “tear-ups”, of outstanding CDS contracts, which totalled \$17.4 trillion, mainly in the multi-name segment (centre panel). Without these terminations, the outstanding notional amounts would have increased by nearly 30%. Terminations were mainly in CDS indices (right-hand panel) and were more pronounced after credit spreads widened. Although most outstanding CDS contracts continued to be between reporting dealers, this segment remained unchanged in terms of outstanding size. In contrast, the outstanding contracts between dealers and other financial institutions declined by 7%. The decrease for insurance companies was 21%, while that for securities firms, the largest segment, was 2%.

Credit default swaps



¹ In billions of US dollars. ² In trillions of US dollars. ³ Notional amounts outstanding at end of period reported to BIS. ⁴ Notional amounts outstanding terminated by TriOptima during period. ⁵ Five-year on-the-run CDS mid-spread on index contracts of investment grade quality, in basis points. ⁶ DJ CDX IG. ⁷ iTraxx Europe.

Sources: JPMorgan Chase; TriOptima; BIS.

Graph A

Since 2003, the private firm TriOptima has been offering multilateral termination services to OTC derivatives dealers, initially for interest rate swaps and subsequently for CDS. A termination cycle consists of two steps. Dealers first provide contract-by-contract information on their derivatives positions, and the firm then checks whether each individual contract is reported by both counterparties with identical terms. In a second step, TriOptima computes a set of bilateral contracts between participants that provides the same net exposures but lowers gross exposures.

More recently, Markit, a specialised CDS data manager, and Creditex, a CDS broker, initiated so-called “compression runs” for single-name CDS contracts. The first compression run ended on 27 August 2008. By end-November, 26 compression runs, 14 in Europe and 12 in the United States, had resulted in a total gross reduction in notional amounts outstanding of single-name CDS contracts in excess of \$1.1 trillion.

contracts expanded by 49% to \$7.6 trillion, and option volume by 81% to \$5 trillion. Growth in gold contracts slowed to 9% (after rising to 40% in the second half of 2007). Gross market values of commodity contracts in total increased by 16% to \$2.2 trillion.

The international debt securities market

Borrowing in the international debt securities market retreated sharply in the third quarter of 2008 amid the continued turmoil in financial markets. Net issuance of bonds and notes decreased to \$247 billion, down substantially from \$1,086 billion in the second quarter. The decline was well beyond normal seasonal patterns, and resulted in the lowest level of net issuance since the third quarter of 2005.¹¹ Money market borrowing also stagnated, with net issuance falling into negative territory in the third quarter.

Borrowing retreats sharply ...

By currency of denomination, the largest decrease in bond and note issuance came from the euro-denominated segment, closely followed by the dollar-denominated segment (Graph 7, left-hand panel). Net issuance of euro-denominated bonds and notes plummeted from \$466 billion in the second quarter to \$28 billion in the third quarter. Net issuance of dollar-denominated bonds and notes also fell sharply, from \$396 billion to \$40 billion. By contrast, net issuance of sterling-denominated bonds and notes remained at a high level of \$153 billion, up from \$144 billion. Strong sterling issuance was attributable chiefly to active issuance of mortgage-backed bonds. Yen issuance decreased from \$16 billion to \$8 billion, although the decline would have been even more pronounced without robust issuance of yen-denominated bonds in Japan by non-Japanese issuers (samurai bonds) of \$7 billion on a net basis.

... particularly in euro-denominated bonds and notes

The breakdown by nationality of issuer indicates that the largest contraction in net issuance came from US borrowers, down from \$308 billion in the second quarter to \$46 billion in the third quarter. A large fall was also seen in the issuance by Belgian, French and UK borrowers.

By sector, financial institutions recorded the largest decline, where net issuance of bonds and notes decreased from \$888 billion to \$246 billion in the third quarter. Corporate issuance also dropped sharply, albeit to a somewhat lesser extent: net issuance decreased from \$133 billion to \$47 billion.

Issuance of international mortgage-backed bonds (for which only gross figures are available) remained relatively active in the third quarter. Gross issuance of mortgage-backed bonds declined from the record level of \$188 billion in the second quarter, but still stood at \$139 billion. Notable decreases were posted by Belgian, Irish and Spanish borrowers, as well as by the US government-sponsored agencies, Fannie Mae and Freddie Mac in particular. By contrast, there was an increase from UK borrowers, up further from \$90 billion to \$98 billion, due possibly to the Bank of England's Special Liquidity Scheme that enables UK banks to swap illiquid assets such as mortgage-backed securities for UK Treasury bills.

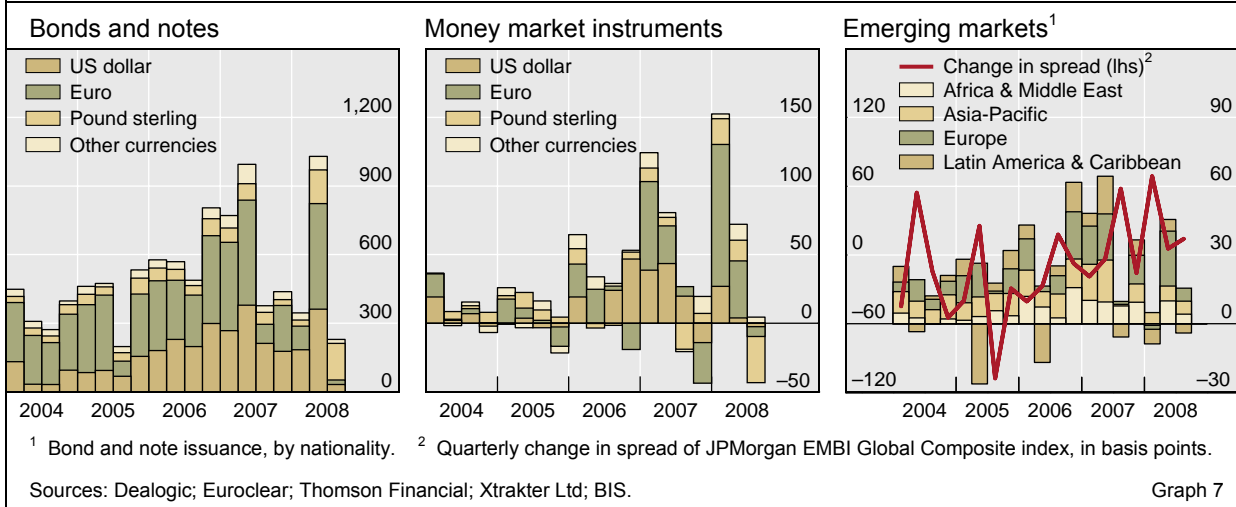
Issuance of mortgage-backed bonds remains relatively active

In the emerging economies, net issuance of bonds and notes declined from \$45 billion in the second quarter to \$11 billion in the third quarter (Graph 7, right-hand panel). The decrease was most marked in emerging Europe (where net issuance by Russian borrowers fell from \$13 billion to \$3 billion), followed

¹¹ For seasonal patterns in international bond and note issuance, see J Amato and J Sobrun, "Seasonality in international bond and note issuance", *BIS Quarterly Review*, September 2005.

International debt securities issuance

Net issuance, in billions of US dollars



by Latin America and Africa and the Middle East. By currency of denomination, the largest decrease occurred in the dollar-denominated segment, followed by the euro-denominated segment.

Money market instruments stagnate

Borrowing through international money markets also stagnated. Net issuance of money market instruments entered negative territory, decreasing from \$69 billion to -\$30 billion in the third quarter, the lowest level since the third quarter of 2003 (Graph 7, centre panel). The largest decline was observed in the sterling-denominated segment, followed by the euro-denominated segment.

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

¹ The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS. The authors would like to thank Claudio Borio, Stephen Cecchetti, Robert McCauley, François-Louis Michaud, Frank Packer, Eli Remolona and Roland Sehmke of the BIS as well as Joseph Abate, Martin Daines, Godfried de Vidts, Romain Dumas, Michael Fleming, Ralph Lehnis, Paul Mercier, Andrew Moorhouse, Larry Servidio and Markus Sunitsch for very useful comments and discussions. We also wish to thank the ECB, the European Repo Council, Eurex Repo, ICAP and the Federal Reserve Bank of New York for providing data. Gert Schnabel and Garry Tang provided excellent research assistance.

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)).

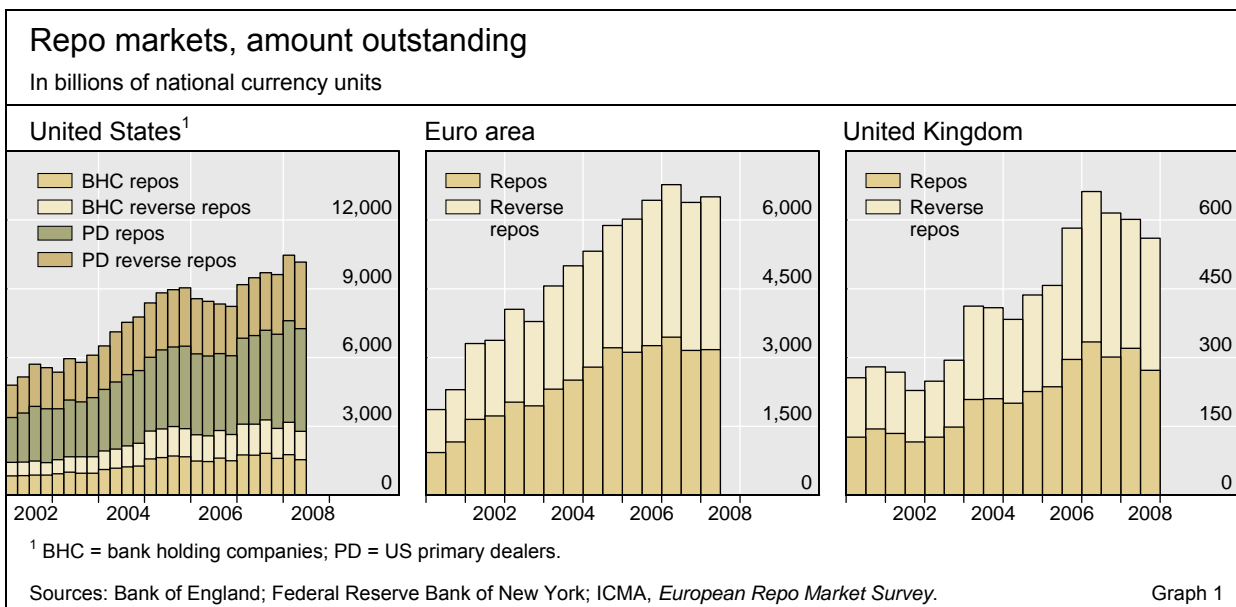
⁴ Central banks, by contrast, view such transactions from the point of view of their bank/dealer counterparties, with repos temporarily adding reserve balances to the banking system while reverse repos temporarily drain balances from the system.

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.

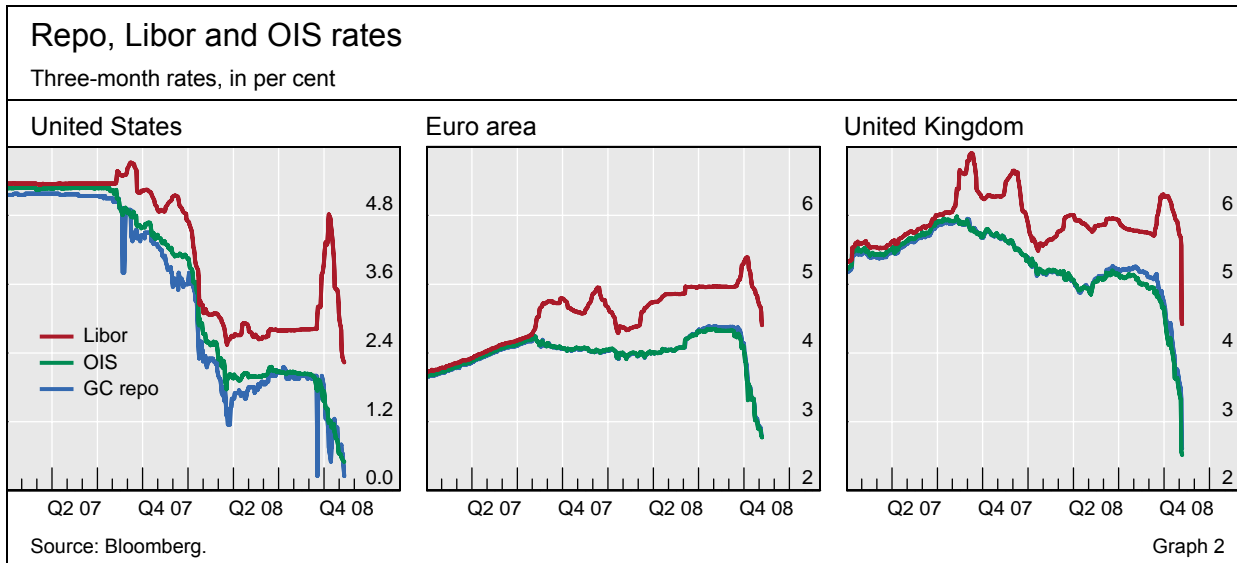
... but have been affected by the onset of the turmoil ...

... 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

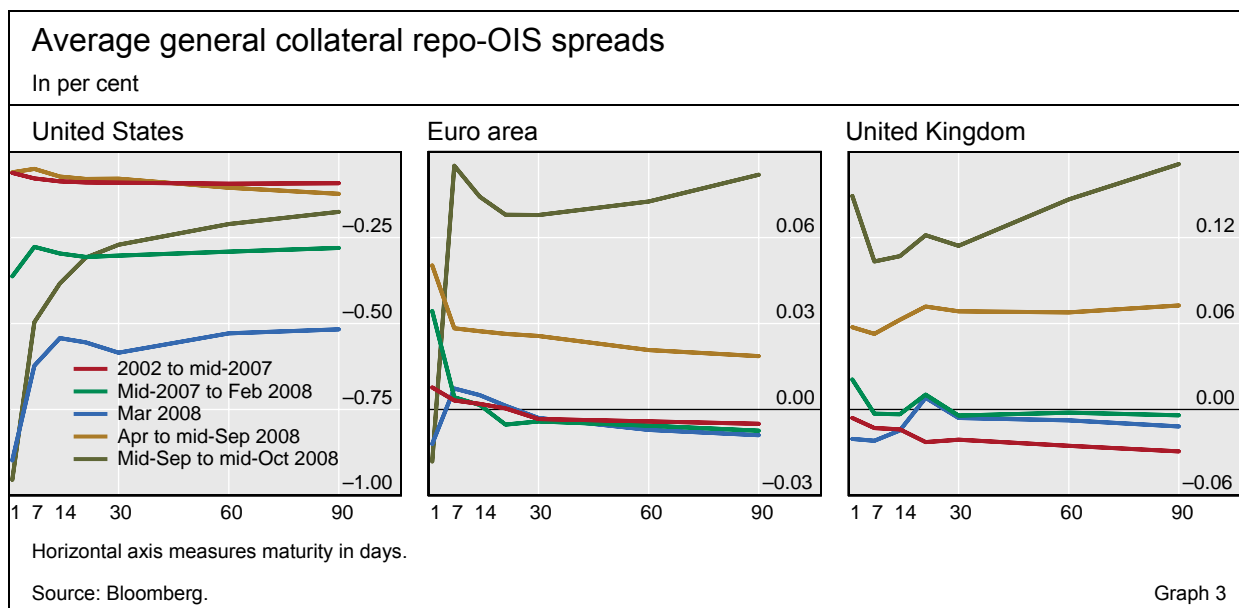
Conditions deteriorate in March ...

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

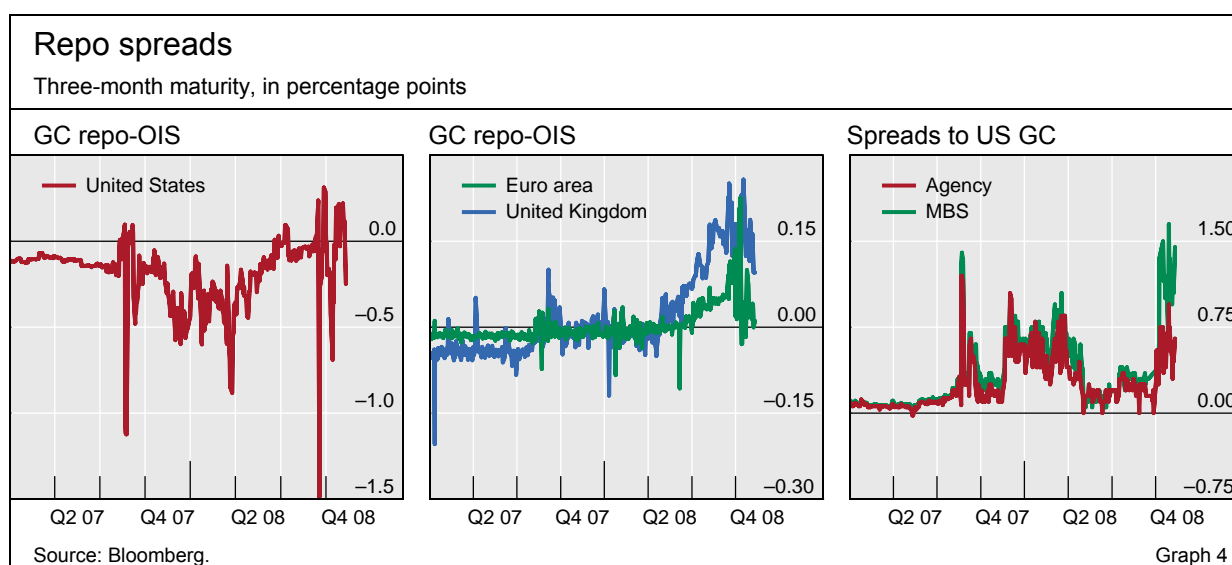
With increased liquidity provision by central banks and government intervention to recapitalise banks in the United States and Europe, strains in money markets began to ease. Repo markets also saw improving conditions, with longer terms becoming available and turnover rising. Repo rates for sovereign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

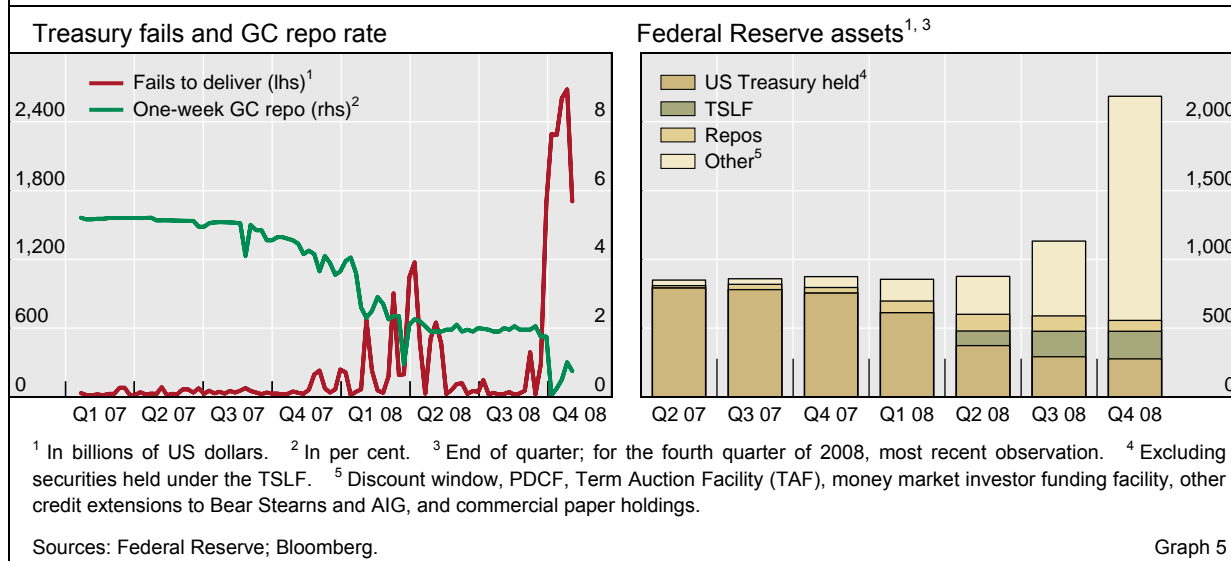
... contributing to the extreme scarcity of US government securities ...

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.

US Treasury fails and Federal Reserve assets



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

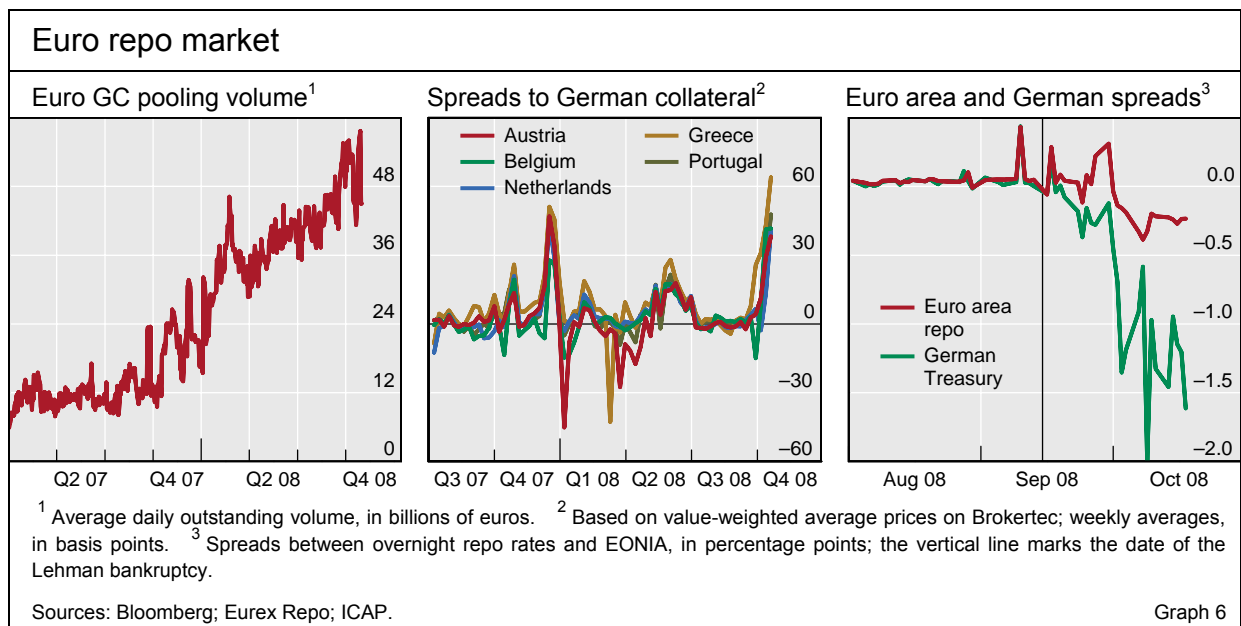
In addition, market initiatives such as Euro GC Pooling have contributed to mobilising GC collateral in the euro area, generating sharp growth rates as the crisis progressed. This system enables repo transactions via a CCP and offers an automated cross-border collateral management system that allows 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 ...

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

... creating facilities to upgrade collateral ...

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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Commodity prices and inflation dynamics¹

Commodity prices rose strongly in recent years until mid-2008, driving inflation up worldwide. This feature investigates aspects of the impact of the rise in food and energy prices on headline inflation and its dynamics using a dataset for CPI inflation and its food and energy components that includes the major advanced and emerging economies. Our evidence suggests that in recent years core inflation has not tended to revert to headline, which suggests that higher commodity prices have generally not spawned strong second-round effects on inflation.

JEL classification: E31, E52.

Commodity prices have risen dramatically in recent years, before falling back markedly since mid-2008 as the financial crisis has led to downward revisions in expectations of future demand growth. The rising commodity prices of recent years have driven inflation higher worldwide. How should monetary policymakers react? If the food and energy price shocks are transitory, with upward spikes that are quickly reversed leaving the medium-term aggregate price path unchanged, policymakers would probably want to ignore them. Even if commodity prices do not revert to their previous level, the temporary inflationary impulse from a rise in the level of commodity prices themselves will soon drop out, and such a relative price shift could be safely accommodated. The alternative – keeping inflation close to policymakers' objective in the short term – would create output costs that could be unduly large. Nevertheless, it is essential that monetary policy resist any second-round effects of higher commodity prices on inflation expectations and wages, and thereby on future inflation itself.

Monetary policymakers face a number of challenges in dealing with higher inflation arising from increases in commodity prices. Prime among them is the fact that in real time it is difficult to distinguish relative price shifts from a rise in aggregate inflation due to strong aggregate demand. Because commodity prices are relatively flexible and might respond to shocks faster than the prices of other goods and services, their increase could signal more general

¹ The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS. The authors would like to thank Clara García and Philippe Hainaut for excellent research assistance, and Piti Disyatat, Dietrich Domanski, Luci Ellis, Michael King and Marion Kohler for helpful comments and discussions.

inflationary pressures. Moreover, it is difficult to identify either whether increases in commodity prices are transitory or permanent, or whether they are likely to generate second-round effects on headline inflation.

This special feature investigates several aspects of the impact of rising food and energy prices on the level and dynamics of inflation in a cross section of mature and emerging economies. We study the potential for second-round effects by analysing whether CPI inflation excluding food and energy has tended to revert to headline inflation, and conclude that it has not, which suggests an absence of strong second-round effects. We also investigate whether food or energy prices help to forecast inflation, and find that the former have tended to do so to a greater extent than the latter.

When making a cross-country comparison of the impact of food and energy prices on headline inflation, it is desirable to have data that are consistent across countries. With this in mind, we employ a cross-country dataset for CPI inflation and its food and energy components that includes the major advanced and emerging economies, and in whose construction some progress has been made towards such cross-country consistency (Domanski et al (2008)). Next, we discuss the impact of rising commodity prices on inflation. The following section analyses the aspects of inflation dynamics relevant for monetary policymakers discussed above, and the last section concludes.

Rise in commodity prices and inflation

Commodity prices rose dramatically in recent years until mid-2008 (Graph 1). Oil prices reached record highs in mid-2008, rising to \$145 per barrel (Brent), 470% higher than at the start of 2000. This increase has been due to the combination of increasing global demand, in particular from strong growth in emerging economies, supply disruptions and downward revisions in expectations of future oil supply. Food prices have increased substantially, partly as rising per capita incomes raised food consumption in emerging economies at the same time that there were temporary supply disruptions. Between the start of 2000 and mid-2008, food prices rose by 150% according to the Commodity Research Bureau's spot index of foodstuffs.

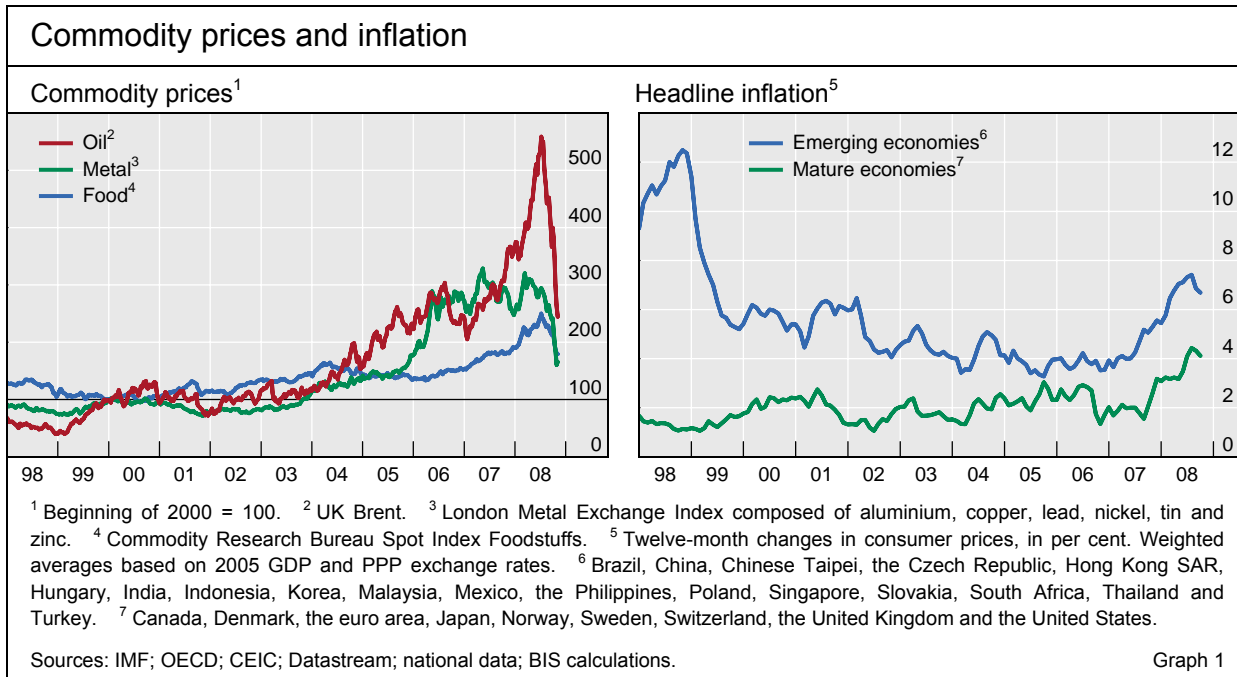
More recently, as the financial crisis has led to downward revisions in expectations of future demand growth, commodity prices have fallen back markedly. Oil prices, for example, declined to around \$65 per barrel (Brent) by the end of October, still 150% higher than the level prevailing at the start of 2000. And as a result of incipient supply responses and fewer weather-related supply disruptions, food prices have also moderated recently.

The rise in food and energy prices has been propelling global inflation upwards in recent years (Graph 1). In mature economies inflation doubled from about 2% several years ago to 4% in mid-2008, and in emerging economies it increased from about 4% to approximately 8%. The relatively higher increase in emerging economy inflation is at least in part a consequence of the larger weight of food in the consumption basket in countries with lower income per capita (IMF (2007)). In the sample of countries considered here, the weight of food in the CPI is around 30% in emerging economies, more than twice the

Commodity prices rose dramatically until mid-2008 ...

... but have fallen back more recently

Inflation has risen globally due to higher food and energy prices



average of 13% in mature economies. Partly as a result, food price increases contributed close to 4 percentage points to the rise in headline inflation in emerging economies in mid-2008, compared with only around 1 percentage point in mature economies (Table 1). In addition, CPI food price inflation tended to be higher in emerging than in mature economies in mid-2008. By contrast, the weight of energy in the consumption basket is more comparable across mature and emerging economies, so it has little impact on the differences in the degree to which inflation has risen around the world. Finally, while headline inflation has increased significantly, core inflation – which excludes food and energy prices that contributed to the strong rise in headline inflation – has remained more subdued in both mature and emerging economies (Graph 2).

Inflation dynamics

In the following, we analyse the aspects of inflation dynamics relevant for monetary policymakers discussed above. Specifically, we address the following three questions: (a) Is headline inflation reverting to core or vice versa? (b) Do food and energy prices help forecast inflation? (c) How persistent are CPI food and energy price inflation?

This feature employs a cross-country dataset for CPI inflation and its food and energy components that includes the major advanced and emerging economies. The CPI food price series is defined as food and non-alcoholic beverages or the closest available series; the CPI energy price series is defined as electricity, gas and other fuels plus fuels and lubricants for personal transport equipment, or the closest available series.²

² The Classification of Individual Consumption by Purpose (COICOP) is a reference classification published by the United Nations Statistics Division. For CPI food prices, the dataset uses the classification COICOP 01, and for CPI energy prices COICOP 04.5 plus

Headline inflation and its contributors in mid-2008 ¹							
	Headline ²	Food ³		Energy ⁴		Non-food non-energy	
		Weight ⁵	Contrib ⁶	Weight ⁵	Contrib ⁶	Contrib ⁶	Actual ²
Mature economies ⁷	3.7	13.3	0.7	7.7	1.4	1.7	2.1
Emerging economies ⁸	8.1	29.5	3.8	7.7	0.9	3.5	5.4

¹ June 2007 to June 2008; unweighted averages of the economies cited; contributions and non-food non-energy actual figures are BIS calculations for purposes of cross-country comparisons and may differ from national sources; contributions may not sum to reported totals due to rounding. ² Change in consumer prices, in per cent. ³ Food and non-alcoholic beverages (COICOP 01) or closest available series. ⁴ Electricity, gas and other fuels (COICOP 04.5), plus fuels and lubricants for personal transport equipment (COICOP 07.2.2) or closest available series. ⁵ As a percentage of headline CPI. ⁶ Contribution, in percentage points. ⁷ Australia, Canada, the euro area, Japan, Sweden, Switzerland, the United Kingdom and the United States. ⁸ Brazil, China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, Mexico, the Philippines, Poland, Singapore, South Africa, Thailand and Turkey.

Sources: OECD; CEIC; Datastream; national data; BIS calculations. Table 1

We consider a core inflation measure obtained by excluding food and energy prices from headline inflation, for which we have a cross-country dataset available.³ The properties of such core inflation measures, as well as of alternative core measures – such as measures based on excluding the most volatile components, or taking median inflation rates across a number of individual prices – have previously been studied for a number of countries, eg in OECD (2005), Rich and Steindel (2005), Blinder and Reis (2005), Marques et al (2003) and Bryan and Cecchetti (1994). For example, Rich and Steindel (2005) evaluate seven different core inflation measures for the United States on criteria including ease of design, accuracy in tracking trend inflation and predictive content for future movements in aggregate inflation. The core measures they consider include inflation excluding food and energy, inflation excluding energy, median inflation and exponentially smoothed inflation. They find that there is no individual measure of core inflation that can be considered superior to other measures based on these criteria.

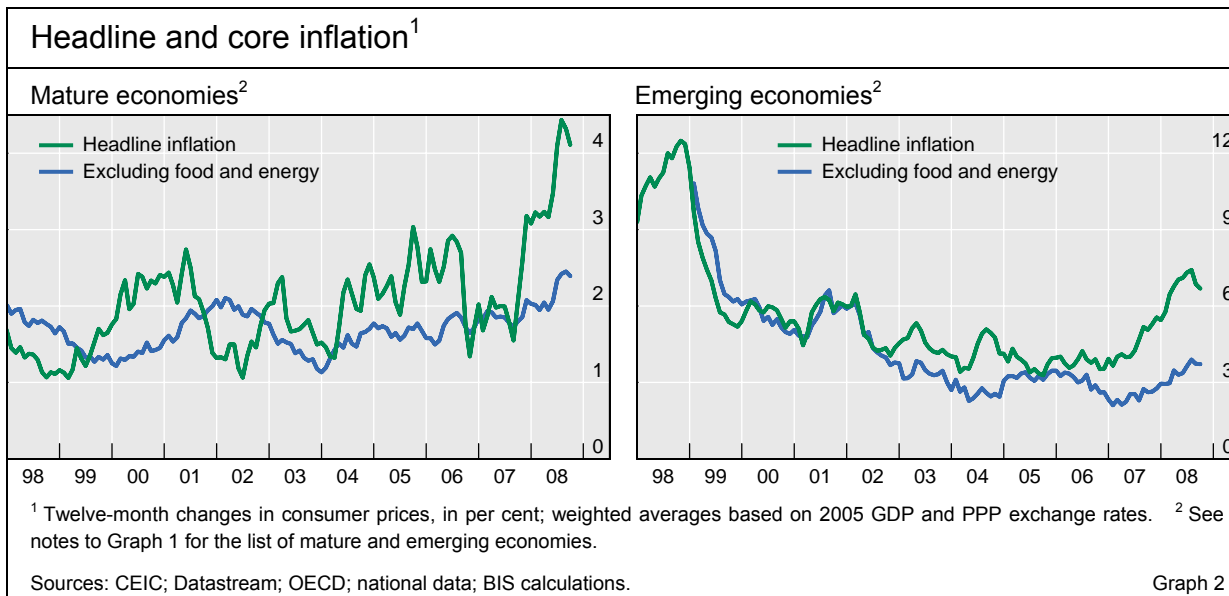
Core inflation measure excludes food and energy prices

The nature of the shocks to commodity prices matters for the impact of rising commodity prices on inflation dynamics. If the source of the recent increases in food and energy price inflation has been the increased income and wealth in strongly growing emerging economies, in particular in East and southern Asia, this could simply lead to a one-off change in the level of food and energy prices if this happened once and for all. However, with economic development in those regions continuing, we might expect that each month there would be a group of new consumers demanding more food and energy, so that demand would shift continuously, which could lead to a more persistent effect on inflation and a smaller degree of reversion of headline inflation to core. By contrast, if higher food and energy prices have mainly been due to

Nature of shocks to commodity prices matters for inflation dynamics

COICOP 07.2.2, or the closest available series. Data for the OECD countries are all consistent and come from OECD sources. For some emerging market countries (eg Brazil), data are consistent, but for some others (eg China, India, Malaysia, the Philippines and Thailand) they are not, and instead the closest available series are taken.

³ CPI inflation excluding food and energy is referred to in the following for simplicity as core inflation.



adverse supply shocks, the impact on inflation might be expected to be more transitory – unless either the supply shocks are themselves persistent, or they lead to second-round effects on inflation.

(a) *Is headline inflation reverting to core or vice versa?*

Has headline inflation been reverting to core?

If headline inflation has been reverting to core, this would provide some comfort to policymakers. It would mean that increases in food and energy inflation have been temporary and have not led to persistently rising headline inflation that could arise from persistent upside shocks to commodity prices or from second-round effects due to higher inflation expectations and accelerating wages. For the United States, there is some evidence that this has been the case as headline inflation has tended to revert to inflation excluding food and energy prices in recent years (Kiley (2008)). US monetary policymakers have also commented on the tendency of headline inflation in the United States to move to inflation excluding food and energy prices in recent years (Rosengren (2008)). For the euro area, as we mention below, the results depend on which measure of core inflation is used (OECD (2005)).

Here we study the question of whether CPI headline inflation reverts to core by considering the following regression:

$$\pi_{i,t}^{headline} - \pi_{i,t-12}^{headline} = \alpha_i + \beta_i (\pi_{i,t-12}^{headline} - \pi_{i,t-12}^{core}) + \varepsilon_{i,t} \quad (1)$$

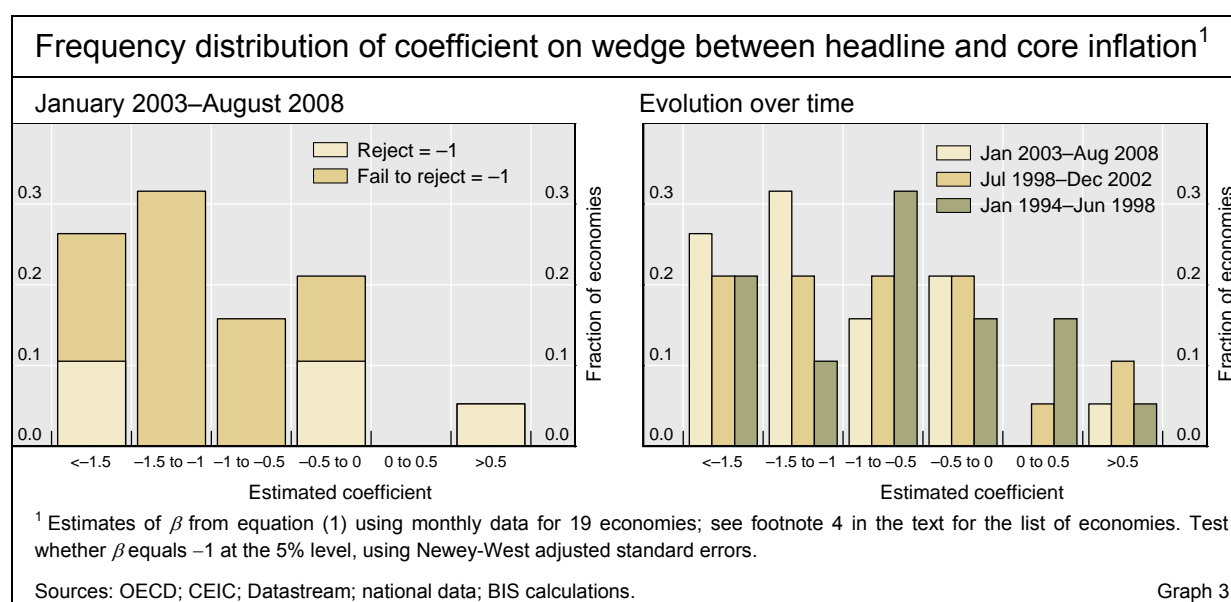
where i labels the 19 economies considered,⁴ using monthly data on year-over-year inflation rates over the past 15 years. If headline inflation reverts to core, we expect a negative coefficient β_i on the wedge between headline and core inflation.

⁴ The 19 economies comprise those for which we have CPI food and energy price data available for the past 15 years, namely Canada, Denmark, the euro area, Japan, Norway, Sweden, Switzerland, the United Kingdom, the United States, China, Chinese Taipei, Hong Kong SAR, Hungary, Indonesia, Korea, Mexico, Singapore, South Africa and Thailand.

Others have applied this regression to study inflation in the United States, the euro area, Japan, the United Kingdom and Canada for the sample period from 1996 to 2004 in OECD (2005), using a range of different core inflation measures.⁵ Across these economies, the study by the OECD (2005) obtained coefficient estimates on the gap between headline and core inflation that were all negative, implying that headline inflation has tended to converge back towards core in these economies. The OECD (2005) study also found that while these coefficient estimates were statistically significantly different from zero for all of the 13 measures of core inflation considered in the case of the United States and Canada, the coefficients were only significantly different from zero for three of the 13 core measures in the case of the euro area. The coefficient estimates were found to be significantly negative for core measures excluding food and energy in the case of the United States, Canada and Japan, but negative and not significantly different from zero for core measures excluding food, alcohol, tobacco and energy in the case of the euro area and the United Kingdom (OECD (2005)).

We can see from Graph 3 that in almost all cases the point estimate of β_i from equation (1) is negative for the sample period starting in 2003 – chosen as the start date of the sample since commodity prices started to rise then (Graph 1). Moreover, in a majority of cases we fail to reject the hypothesis that the estimated coefficient equals -1 , which would hold if headline inflation fully reverts to core (Graph 3).

However, there is a complication in finite samples. The constant term α in equation (1) allows for core inflation being a biased predictor of headline inflation over a given sample period, for example in cases where commodity price shocks are predominantly on the upside or downside. Indeed, over the



⁵ This specification has also been applied to US data for example in Clark (2001), and to Canadian data in Lafèche and Armour (2006). Clark (2001) finds that β is negative and significant at the one-year horizon for the sample period 1985–2000, with values ranging between around -1.3 and -0.8 for six different core inflation measures. Lafèche and Armour

period January 2003–August 2008 the constant term α was significantly positive in a majority of countries. Reflecting this, in a majority of economies we reject at the 5% significance level the joint hypothesis that α equals zero and β equals -1 , ie the hypothesis that headline inflation fully reverts to core within one year. On the other hand, in a majority of countries we also reject the hypothesis that the coefficient β equals zero, which corresponds to a situation where headline inflation does not revert to core.⁶ These results therefore do not allow us to draw definite conclusions on whether headline inflation has been reverting to core.

We also compare the results for the estimated coefficient β in the recent period with those of earlier periods of around five years' duration. While this comparison is only indicative, we can see from Graph 3 that the frequency distribution of the estimated coefficient has tended to shift to more negative values of the coefficient over time.

To continue, we investigate the possibility of core inflation reverting to headline. If core inflation is reverting to headline, this would indicate a worrying development of second-round effects from higher commodity prices causing aggregate inflation expectations to rise, and thereby core inflation to catch up with headline inflation, which monetary policymakers would need to resist. We can investigate this issue by considering the regression:

$$\pi_{i,t}^{core} - \pi_{i,t-12}^{core} = \alpha_i + \delta_i (\pi_{i,t-12}^{core} - \pi_{i,t-12}^{headline}) + \varepsilon_{i,t} \quad (2)$$

for the same 19 economies as those considered in equation (1). A value for the estimated coefficient on the difference between core and headline inflation, δ_i , of zero indicates that core inflation is not reverting to headline. We can see from Graph 4 that in the majority of cases we fail to reject the hypothesis that δ equals zero, ie that core inflation is not reverting to headline. Similarly, in the majority of cases we fail to reject the joint hypothesis that both the constant α and the coefficient δ equal zero. By contrast, in a majority of countries we do reject at the 5% significance level the joint hypothesis that α equals zero and δ equals -1 , ie the hypothesis that core inflation fully reverts to headline.

Moreover, over time the frequency distribution of the coefficient on the wedge between core and headline inflation, δ_i , has become more peaked at the interval from -0.5 to 0 , while the frequencies in the tails of the distribution have decreased (Graph 4).

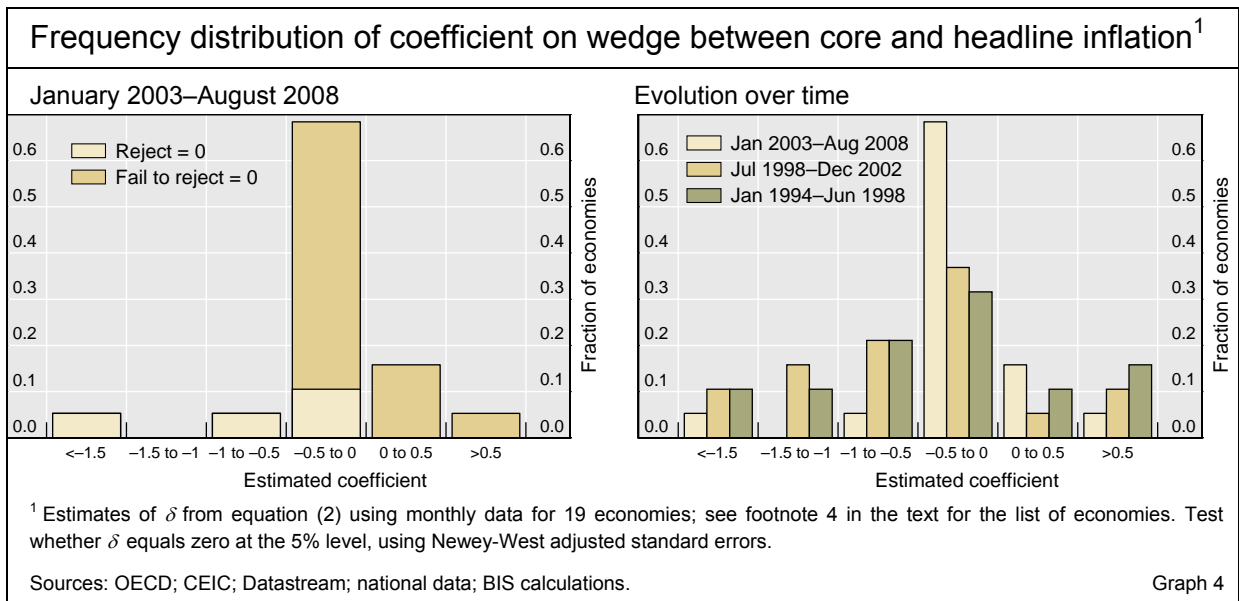
This evidence suggests that, generally, core inflation does not revert to headline inflation, and that, if anything, the incidence of core reverting to headline is now lower than a decade ago.

(2006) find that headline inflation has tended to revert to core, but they find little reversion of core inflation to headline.

⁶ We also reject the joint hypothesis that both α and β equal zero in a majority of countries.

Has core inflation been reverting to headline?

Core inflation has not tended to revert to headline in the majority of countries



(b) Do food and energy prices help forecast inflation?

Since monetary policy can affect inflation only with a lag, policymakers are interested in identifying timely signals of future inflation developments in order to produce the best inflation forecasts used to inform policy decisions. Here we investigate whether CPI food and energy prices have helped to forecast headline inflation by considering the following forecasting regression:

$$\pi_{i,t}^{headline} = \alpha_i + \sum_{k=1,12} \beta_{ik} \pi_{i,t-k}^{headline} + \sum_{k=1,12} \gamma_{ik} \pi_{i,t-k}^{food} + \varepsilon_{i,t} \quad (3)$$

This regression answers the following question: does past food price inflation in country i , $\pi_{i,t-k}^{food}$, help to predict headline inflation, once we have taken account of the autocorrelation in headline inflation itself? This is the case if the sum of the coefficients on lagged food price inflation, $\gamma = \sum_{k=1}^{12} \gamma_{ik}$, is significantly different from zero. We run a similar regression for energy prices, by replacing past food price inflation with past energy price inflation, $\pi_{i,t-k}^{energy}$, in equation (3).⁷

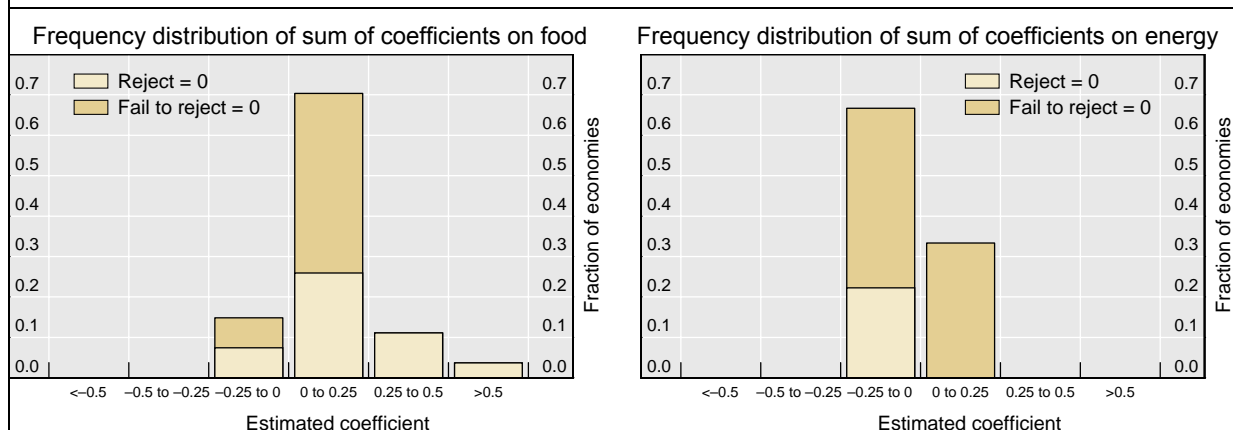
Graph 5 reports the estimates for the sum of the coefficients on past food and energy price inflation for 27 economies. We find some evidence that food price inflation helps predict future headline inflation, but there is little reason to think that energy prices do. This could be related to the fact that food price inflation in the CPI tends to be more persistent than CPI energy price inflation, as discussed in the next section. However, the sample period starting in 2003 when commodity prices started to rise is relatively short, so that the power of the tests might be relatively low for drawing firm conclusions.

Do food and energy prices help forecast inflation?

Some evidence to suggest that food prices help forecast inflation

⁷ If food or energy constitutes a significant share in the CPI, such as in some emerging economies, there could be some issue of multicollinearity in equation (3).

Forecasting headline inflation¹



¹ For food prices, estimates of the sum of coefficients on lagged food price inflation from equation (3) using monthly data on 12-month inflation rates for 27 economies (and similarly for energy by replacing food with energy inflation in the equation); see notes to Graph 1 for the list of economies. Test whether γ is zero at the 5% level. Regressions are monthly with 12 lags over the period from January 2003 to August 2008.

Sources: OECD; CEIC; Datastream; national data; BIS calculations.

Graph 5

(c) How persistent are CPI food and energy price inflation?

In deciding how to react to price increases, such as those of food and energy prices, policymakers need to know whether the price increases are temporary or persistent. If it is the former, then commodity price increases are less likely to affect headline inflation over the medium-term horizon relevant for monetary policy, and the price increases can safely be ignored. If, however, food and energy price increases are very persistent, then they are more likely to affect inflation over the horizons relevant to policymakers. It is this second case, in which food and energy price changes affect inflation expectations creating the risk of second-round effects, which is of great concern to policymakers.

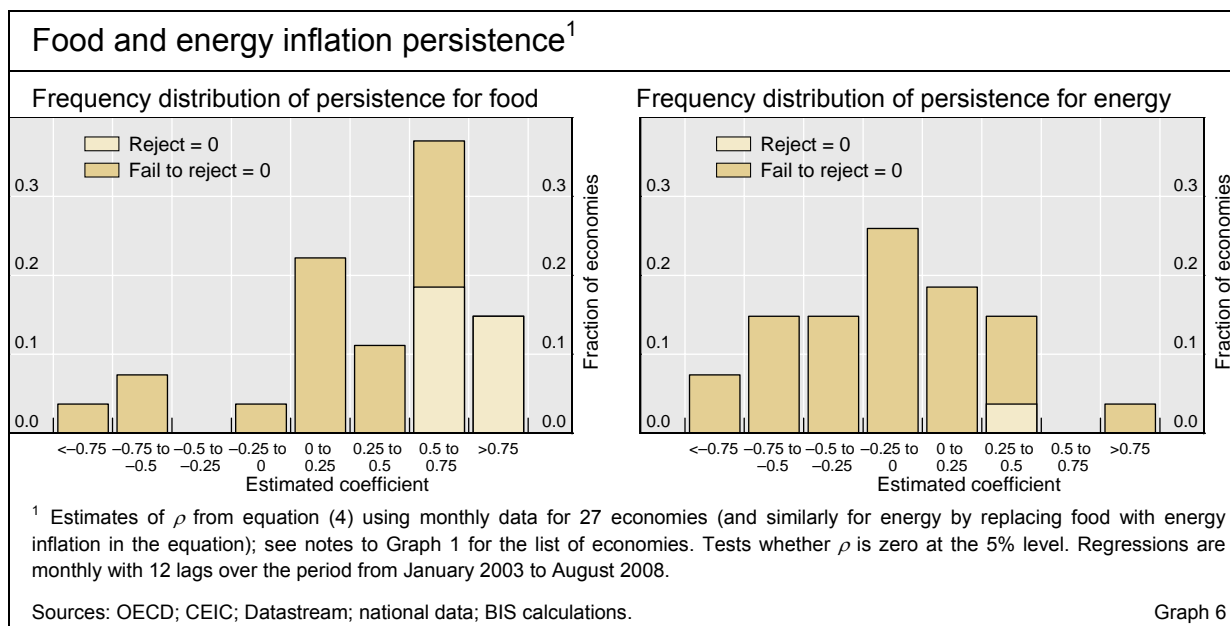
We measure the persistence of food price inflation (and similarly of energy price inflation) as the sum, $\rho = \sum_{k=1}^{12} \rho_{ik}$, of the autoregressive AR(12) coefficients on lagged food price inflation in the following regression, estimated over the past five and a half years:

$$\pi_{i,t}^{food,m} = \alpha_i + \sum_{k=1}^{12} \rho_{ik} \pi_{i,t-k}^{food,m} + \varepsilon_{i,t} \quad (4)$$

Here, $\pi_{i,t}^{food,m}$ is the monthly change in seasonally adjusted food prices (seasonally adjusted using the X-12 procedure). The sum of autoregressive coefficients, proposed by Andrews and Chen (1994), is a common measure used in the literature on inflation persistence. It is related to the speed with which inflation converges back to its baseline value following a shock.

In a majority of countries, we fail to reject the hypothesis that the sum of the coefficients on lagged food price inflation is significantly different from zero (Graph 6). This is also the case for energy price inflation. Food price inflation nevertheless seems to exhibit somewhat greater persistence than energy price inflation. The estimated measure of persistence, ρ , for food price inflation is significantly greater than zero in more countries than is the case for energy

Food price inflation seems to be more persistent than energy inflation



price inflation (Graph 6). Moreover, the mean of the values for this measure of persistence which are significantly different from zero is higher for food prices than for energy. However, given the relatively short sample period, the statistical power of these tests might be relatively low, so we caution against drawing any firm conclusions. Furthermore, this measure of persistence can depend importantly on the length of the sample period as well as on whether shifts in the mean of inflation are allowed for in the estimation.⁸ Cecchetti and Debelle (2006) show that, for a range of mature economies, the estimated persistence tends to be lower for shorter sample periods and if mean shifts are allowed for. In another study, Angeloni et al (2006) find time variation in estimated persistence for CPI food and energy price inflation in the euro area and the United States.

The finding in the forecasting regression above suggests that food price inflation seems to have greater additional explanatory power for headline inflation than energy price inflation. This may be related to the fact that food price inflation in the CPI has tended to be somewhat more persistent than energy price inflation.

Conclusions

In this special feature, we have investigated aspects of the impact of the rise in food and energy prices on the level and dynamics of headline inflation. We found that in recent years core inflation has generally not tended to revert to headline inflation in a majority of (but not all) countries considered. This evidence suggests an absence of strong second-round effects of higher commodity prices on inflation in a majority of countries over the period considered.

⁸ An overview of the implications of inflation persistence for monetary policy design can be found in Levin and Moessner (2005).

We also report evidence suggesting that in recent years food price inflation has tended to have greater additional explanatory power for future headline inflation than energy price inflation, and seems to have been somewhat more persistent. However, the sample period starting in 2003 when commodity prices started to rise is relatively short, so that the power of the tests might be relatively low for drawing firm conclusions.

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Bank health and lending to emerging markets¹

Over the past decade, many emerging markets have increased their dependence on credit from foreign banks. However, the ongoing financial crisis may prompt banks to reassess their exposures to these economies. Panel regression analysis of data since the early 1990s indicates that a deterioration in bank health is associated with a decline in the growth of credit to emerging markets.

JEL classification: F34, G15, G21.

The ongoing financial crisis has raised questions about the resilience of international bank credit to emerging markets. Severe funding constraints caused by liquidity shortages in the interbank market and, more recently, market concerns about banks' health have prompted banks to reassess their global balance sheet positions.² Emerging markets may be vulnerable since a significant reduction in foreign bank credit could have a negative impact on the real side of these economies, particularly those which have relied heavily on financing from banks that have been at the centre of the storm.

To cast some light on these issues, this article examines the link between bank health and foreign bank credit to emerging markets from a long-term perspective. The first section highlights emerging markets' growing dependence on such credit, and summarises the evolution of internationally active banks' exposures to these borrowers since the early 1990s. The extent to which these exposures have been generated by banks' offices in the borrower countries differs significantly across emerging markets. Since these local claims are often funded locally, they are arguably less sensitive to external shocks than banks' cross-border credit.

The second section analyses how foreign banks' credit to emerging markets responded to changes in bank health and global market conditions prior to the ongoing financial crisis. The analysis relies on a panel regression framework that incorporates the BIS international banking statistics, which track credit from the world's major banking systems to emerging markets. A robust finding is that deterioration in banks' health and stresses in mature

¹ The views expressed are those of the authors and do not necessarily reflect those of the BIS. The authors would like to thank Emir Emiray and Carlos Mallo for valuable help with the data.

² See the Highlights section on the international banking market on pages 25–30 of this issue.

interbank markets from the early 1990s to mid-2007 consistently led to slower growth in international credit to emerging markets. By contrast, locally extended credit was largely insensitive to changes in creditor banks' health.

The third section considers developments in bank lending to emerging markets since mid-2007. Out-of-sample predictions based on the regression estimates provide a useful benchmark for evaluating the actual extension of credit during the recent period of stress. The general finding is that credit growth to emerging markets between mid-2007 and mid-2008 was stronger than what might have been expected given the regression estimates. That said, there are signs that, for some banking systems, the growth in credit to emerging markets has slowed.

Trends in foreign bank credit to emerging markets

Overall, foreign bank credit to emerging markets has expanded significantly in recent years. Outstanding foreign claims on these economies quadrupled after mid-2002, reaching \$4.9 trillion by mid-2008. Against this backdrop, the financial crisis has brought to the fore concerns related to the size of these exposures and to the sustainability of emerging markets' dependence on foreign bank credit.

This section examines the size of foreign bank credit to emerging markets, first from the perspective of borrower countries and then from that of creditor banking systems. The analysis relies on the BIS consolidated banking statistics reported on an immediate borrower basis, which provide internationally comparable measures of national banking systems' exposures to country risk. Banks headquartered in a particular reporting country provide information on their foreign claims on borrowers in up to 200 vis-à-vis countries. Foreign claims equal "international" claims plus local currency claims extended by offices in the borrower country, or "local-in-local" claims. In turn, banks' international claims equal cross-border claims in all currencies plus foreign currency claims extended by offices in the borrower country.

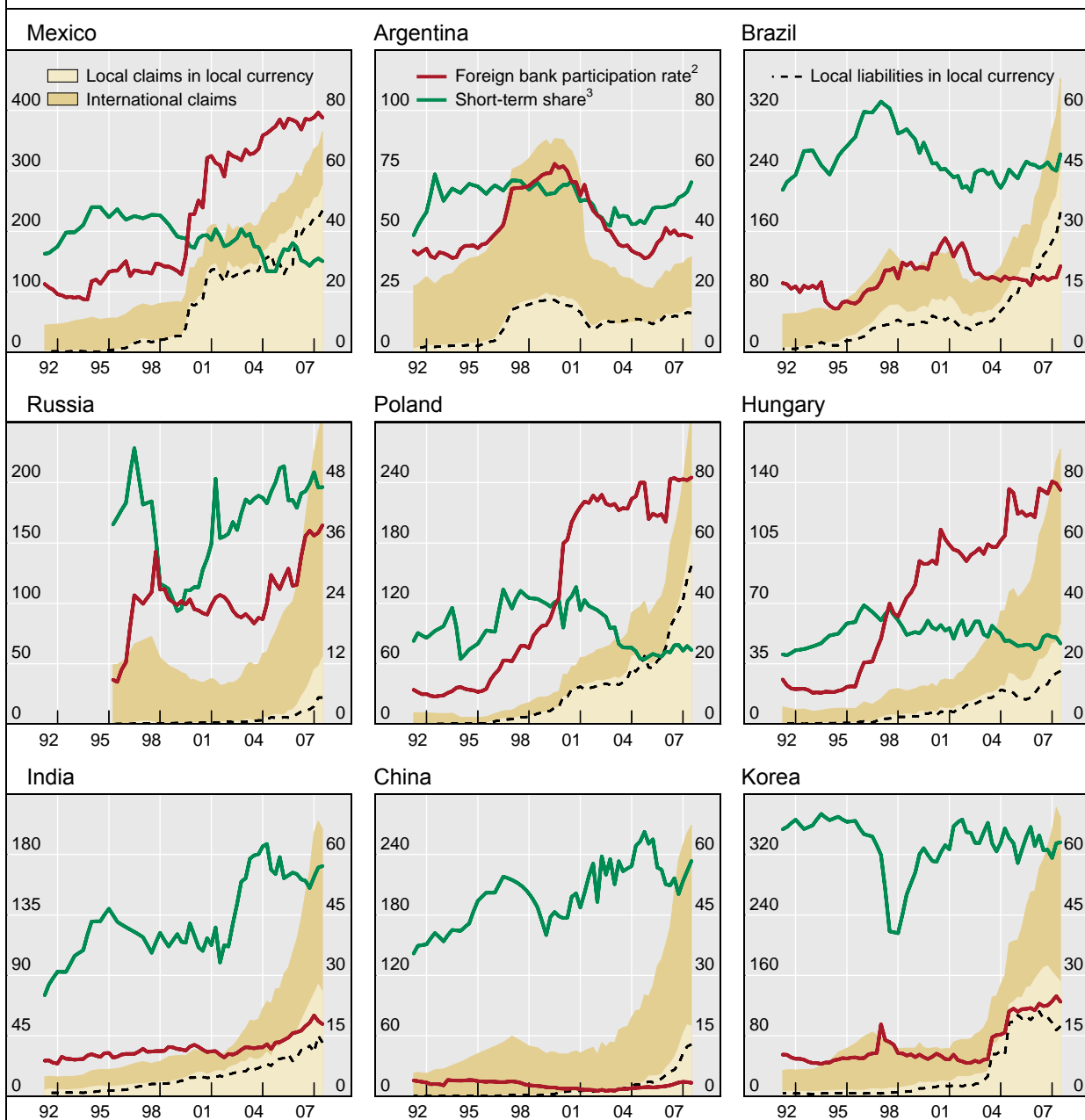
Dependence of emerging markets on foreign bank credit

BIS reporting banks' claims on almost all emerging markets reached all-time highs in 2008 (Graph 1). Foreign claims on the new EU member states have been growing strongly since 2000, reflecting the integration of these economies with the rest of the continent. For example, through mid-2008, claims on Hungary rose sevenfold, while claims on Poland and the Czech Republic increased by a factor of 10. Over the same period, foreign claims on Russia and on the major emerging markets in Asia-Pacific roughly quintupled. By contrast, foreign claims on Latin American countries, which experienced regional financial crises at the beginning of the decade, grew more slowly or even fell in some cases. For example, in mid-2008, the outstanding amount of foreign claims on borrowers in Argentina stood at half its 2001 level.

Many emerging markets appear to have grown increasingly *dependent* on credit from foreign banks. A direct measure of such dependence is the foreign

Foreign bank credit has surged since 2000 ...

Foreign claims on selected emerging markets¹



¹ Shaded areas and dashed lines are billions of US dollars (lhs); solid lines are shares, in per cent (rhs). The sum of international claims (cross-border claims in all currencies and foreign currency claims extended locally by foreign offices) and locally extended claims in local currency equals total foreign claims. Some reporting banking systems do not provide information on their local liabilities in local currency (eg Austria). ² See footnote 3 in the text for a description of how this rate is calculated. ³ Share of short-term claims in total international claims.

Sources: IMF; BIS consolidated statistics; BIS locational statistics by residency.

Graph 1

bank participation rate, or the share of the total credit received by the non-bank residents of a particular country which is extended by foreign-headquartered banks (red lines in Graph 1).³ This rate has been increasing steadily since

³ More precisely, the numerator of this ratio equals the sum of BIS reporting banks' international claims on non-banks in country *k* and these banks' total local-in-local claims on country *k*, both from the consolidated statistics. The assumption is that local-in-local claims, for which the BIS statistics do not provide a sectoral breakdown, are extended to non-banks

1990 in Poland, Hungary and Mexico and stood at roughly 80% in the second quarter of 2008. In Argentina, the measure of dependence on foreign bank credit declined after the crisis in 2001–02 but is currently rather high at 40%, similar to that in Russia. By contrast, credit extended locally by Chinese, Indian and Korean banks has kept up with the rise in foreign claims, leading to lower foreign bank participation rates.⁴

Several factors might arguably affect the extent to which foreign claims adjust to shocks originating outside the borrower country.⁵ One is the share of local-in-local claims in the total foreign claims on particular economies. Local-in-local claims (light shaded areas in Graph 1) tend to be funded by local-in-local liabilities (dashed black lines) and are also likely to reflect long-term incentives of foreign banks to buttress their strategic role in particular emerging markets. Thus, for a given level of dependence on foreign banks, countries where most foreign bank credit is in the form of local-in-local claims are likely to be more insulated from shocks that affect creditor banks but are external to the respective economies.⁶ This suggests that Mexico might be less vulnerable to such shocks than Hungary, and Brazil less vulnerable than India (Graph 1).

... driven by banks' local operations

Another factor that influences the sensitivity of bank credit to adverse shocks is the residual maturity structure of this credit (Graph 1, green lines). Information about residual maturity is available only for international claims. A greater share of short-term international claims leaves borrowers more exposed to rollover risk and, thus, to shocks affecting creditor banks.⁷ This share has differed across emerging markets, ranging from roughly 30% in the case of Hungary, Mexico and Poland to 50% or more for Brazil, China, India and Korea.

Short-term claims have greater rollover risk

only. The denominator of the ratio is the sum of domestic credit to non-banks in country k (from the IMF International Financial Statistics) and BIS reporting banks' total cross-border claims on non-banks in country k (from the BIS locational banking statistics by residence). See BIS *Quarterly Review*, June and September 2005, for further discussion.

⁴ Another, less direct measure of dependence is the ratio of foreign bank claims to borrower country GDP. Outstanding foreign claims on many emerging European economies in mid-2008 amounted to between 100 and 200% of annual GDP, up from 50% or less in 2001.

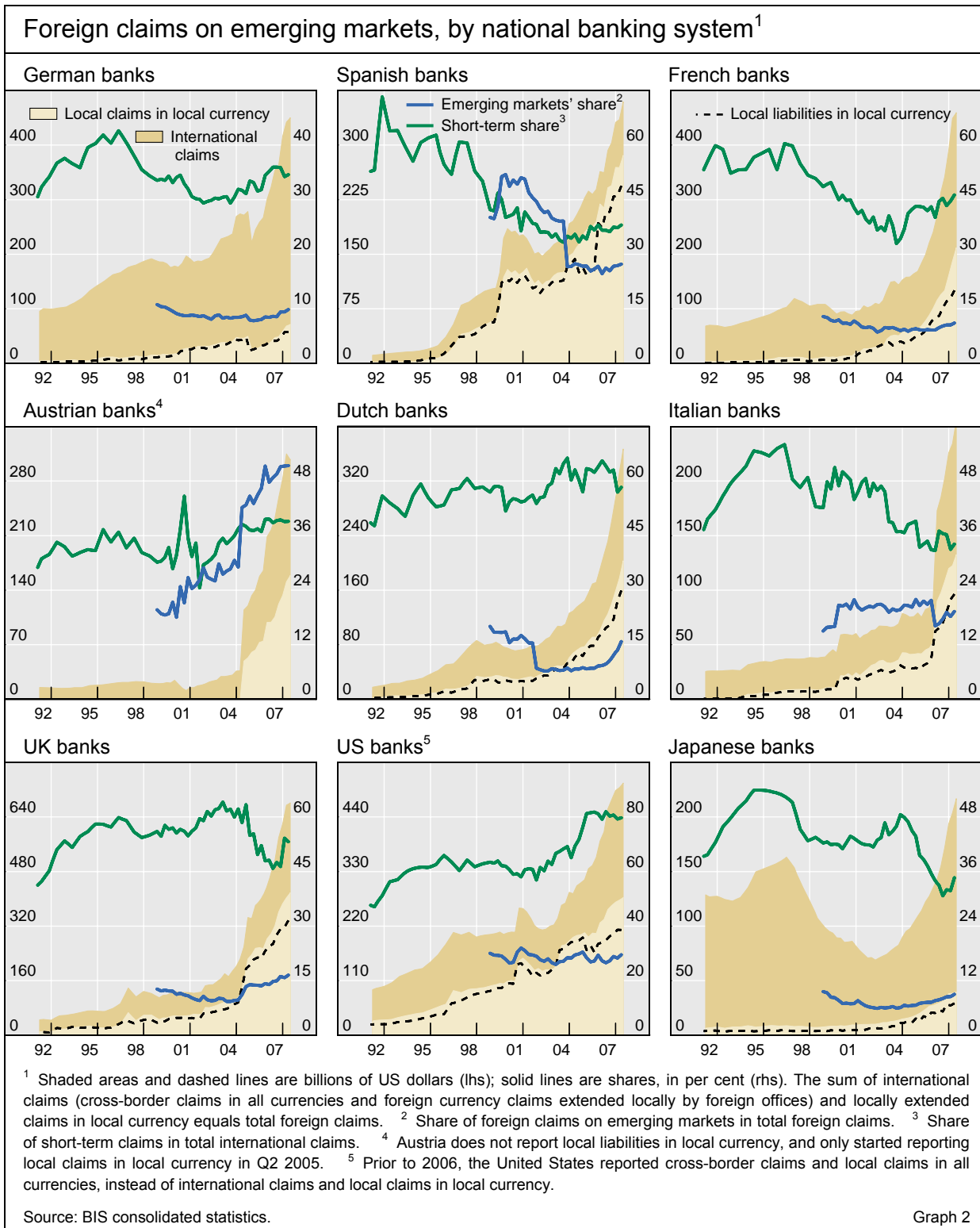
⁵ A large literature (eg Claessens et al (2001), Cull and Martinez-Peria (2007), Detragiache et al (2008) and Domanski (2005)) has analysed the extent to which foreign banks affect the efficiency, risk management standards and financial stability of emerging markets. In addition, Peek and Rosengren (2000) find that, in contrast to local-in-local claims, cross-border claims on emerging markets tend to contract during periods of stress.

⁶ This argument would be weakened if, for example, funding problems in their home countries induce banks to tap deposits in emerging markets in order to finance lending elsewhere.

⁷ The degree to which external shocks are transmitted to emerging markets also depends on the maturity structure of creditor banks' *liabilities*. Specifically, these banks are themselves more vulnerable to shocks when a greater share of their liabilities are short-term. However, the BIS international banking statistics do not include information on the maturity structure of liabilities.

Banks' exposures to emerging markets

Graph 2 shows foreign claims on all emerging markets from the perspective of reporting banking systems. For most, the growth rate of foreign claims accelerated in the current decade, especially in the case of UK and Italian banks. The noteworthy exception is Japanese banks, whose withdrawal from



Asia-Pacific emerging markets during and after the 1997 Asian financial crisis has reversed only since 2003.

Despite being large from the borrowers' perspective, foreign claims on emerging markets are generally a small portion of banks' total foreign claims. This share has remained quite stable for most of the major banking systems, ranging between 10% and 20% since 1999 (Graph 2, blue lines). Austrian banks, whose claims on emerging markets in mid-2008 accounted for roughly half of their total foreign claims, are an exception.

Exposures are generally small relative to total assets ...

The structure of foreign claims differs significantly across banking systems. As noted above, banks may adjust their international more than their local-in-local claims in response to shocks originating outside the borrower country, primarily because international claims are more likely to require external funding. At one end of the spectrum, local-in-local claims account for the bulk of Spanish and Dutch banks' total foreign claims on emerging markets. At the other, they represent less than 20% of German and Japanese banks' total foreign claims on these borrowers.

... and differ by type ...

The residual maturity of international claims, a determinant of the ease with which banks can adjust their exposures, also differs across banking systems. In the case of Dutch and US banks, for example, the short-term share of total international claims on emerging markets has been on an upward path since the beginning of the 1990s and currently stands at roughly 60% and 80%, respectively. These banks should, in principle, be in a position to adjust large portions of their exposures to emerging markets relatively quickly. By contrast, Spanish, Italian and Japanese banks do not enjoy such flexibility. Hovering at around 60% by the mid-1990s, the share of short-term credit in these banks' exposures to emerging markets declined steadily thereafter to below 40% by mid-2008.

... and by maturity

Determinants of foreign bank lending to emerging markets

Existing work on the determinants of foreign credit to emerging markets has often relied on the BIS international banking statistics, and thus offers some guidance in terms of both model specification and the choice of possible explanatory variables.⁸ Indeed, a recent study has found a strong link between total lending to emerging markets and indicators of funding pressures in global interbank markets (World Bank (2008)).

The analysis below builds on this literature, but with a sharper focus on the relationship between banks' health and the growth in credit to emerging markets. It relies on market-based indicators of bank health, and separately

Potential drivers of claim growth include ...

⁸ A large part of this existing work attempts to explain foreign bank lending to emerging markets using "gravity" models in which the size of bilateral linkages is related to home and host country macroeconomic variables as well as geographic, historical and institutional factors (Rose and Spiegel (2002) and Papaioannou (2008)). Other related articles focus on total borrowing by emerging market countries, and explain the mix of local and cross-border lending by foreign banks with local macroeconomic variables (Garcia-Herrero and Martinez-Peria (2005)). In turn, Goldberg (2001) finds that US banks' lending to emerging markets is sensitive to US macroeconomic conditions.

examines how changes in these indicators affect the growth rate of international and local-in-local claims.

Empirical strategy

The empirical analysis is based on a panel regression specification where the dependent variable, $Y_{j,k,t}$, is the growth rate of either the stock of international claims or local-in-local claims reported by banking system j on borrowers in emerging market k .⁹ The general specification can be written as follows:

$$Y_{j,k,t} = \alpha_{j,k} + \beta_1 X_{j,t}^1 + \beta_2 X_{k,t}^2 + \beta_3 X_{j,k,t}^3 + \varepsilon_{j,k,t}$$

... indicators of
bank health ...

where the X^i matrices denote three blocks of explanatory variables. The first block is comprised of indicators of funding conditions and bank health, and is the primary focus of the analysis (Graph 3). This block includes the spread between three-month US dollar Libor and the three-month US Treasury rate (TED spread), an increase in which is thought to signal funding pressures in the interbank market. This block also includes bank health indicators *specific* to each national banking system j : banks' equity returns,¹⁰ banks' average expected default frequencies (EDFs) and the volatility of the market value of banks' assets.¹¹ A rise in EDFs or asset volatility, or a drop in equity returns, would indicate a perceived deterioration in banks' health and is expected to be associated with slower credit growth to emerging markets.

... macroeconomic
controls ...

The second block contains a set of *control* variables that capture country-specific macroeconomic conditions. It includes real GDP growth rates (current and lagged) for both the banking system's home country and the borrower country, and the (current and lagged) percentage change in the borrower country exchange rate against the US dollar. The block also includes a one-period lag of the *overall* rate of foreign bank participation in the borrower country as a measure of banking system openness ("FBP overall" in Table 1).

... and measures of
bilateral linkages

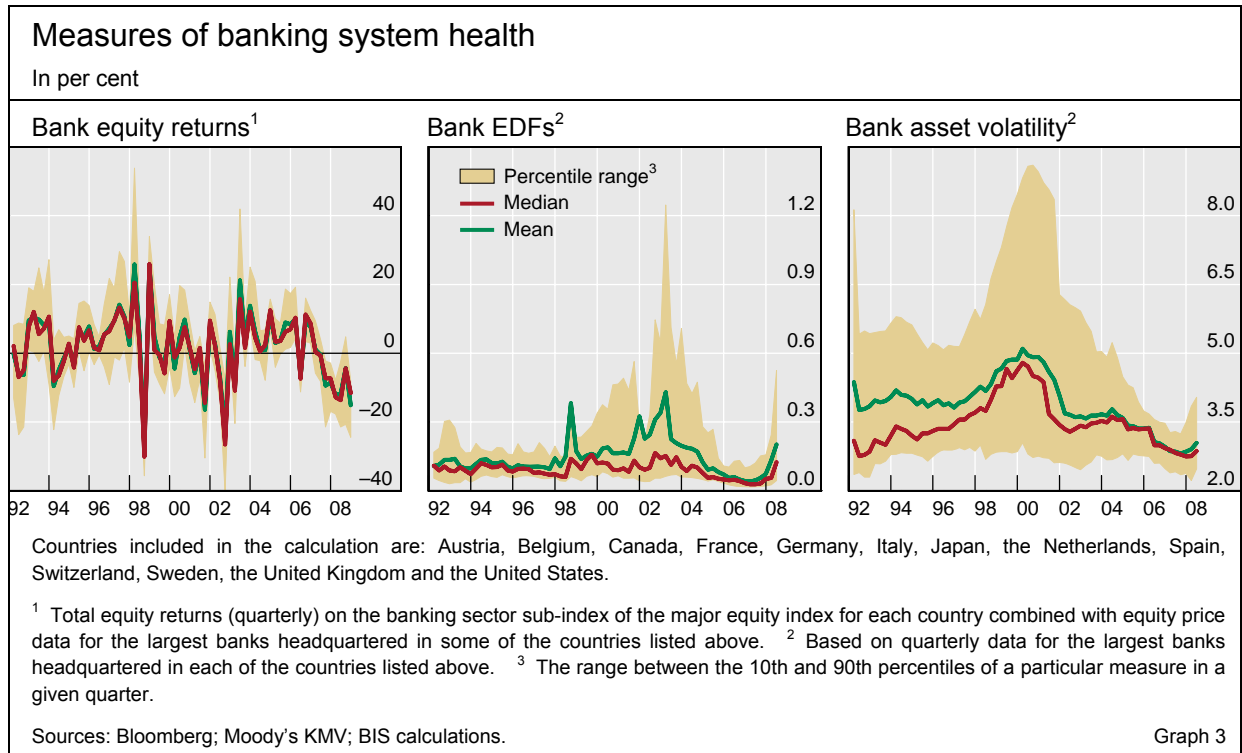
The third block contains a set of controls to capture bilateral characteristics that could have an effect on credit growth. It includes the real short-term interest rate differential, an increase in which would signal a rise in the relative rate of return on investment in emerging markets. In addition, it includes the growth in the banking system's home country's exports to and imports from the borrower country, which are expected to enter with a positive sign, as well as the banking system-specific foreign bank participation rate in

⁹ The consolidated banking statistics were reported semiannually until 1999, and quarterly thereafter. Non-overlapping semiannual growth rates are used in the empirical analysis. These are calculated based on outstanding stocks of claims which have been booked in various currencies but reported in US dollars (converted using contemporaneous exchange rates). Thus, the growth rate of claims is affected by movements in exchange rates.

¹⁰ The "banking sector" sub-index (or closest equivalent) of the major stock market index for each reporting country is used to measure banks' equity returns. For some countries, this is supplemented with stock price data for individual banks headquartered in that country.

¹¹ Estimates of banks' EDFs and asset volatility are from Moody's KMV. Bank-level figures are averaged to generate time-varying health measures for each banking system. Only data for large internationally active banks are used.

borrower country k (“FBP specific” in Table 1). All else equal, claim growth should be higher vis-à-vis countries with more open financial systems, as



captured by the *overall* foreign bank participation rate mentioned above. However, individual banking systems which account for a larger share of total credit to non-banks in a particular borrower country k may find it difficult to further expand their presence. If so, the banking system-specific rate of participation should enter the regression with a negative sign.

Data availability places some restrictions on the size and dimension of the panel data used in the analysis. The sample is unbalanced in the sense that not all data are available for all borrower countries and banking systems for the first half of the 1990s. The estimates presented below are based on a sample covering the period from Q1 1992 (or earliest available for each creditor-borrower pair) through Q2 2007, which excludes the recent period of financial crisis. Only those creditor-borrower pairs where total foreign claims exceed \$1 billion at least once during the sample period are retained, leaving a panel of 13 banking systems and 19 emerging markets. Many growth rate observations are extremely large, primarily due to bank mergers or to new institutions entering the reporting population of banks, both of which can lead to sudden jumps in the outstanding stock of claims vis-à-vis particular countries. To address this, a dummy variable which equals one for any growth rate above the 95th percentile in the pooled sample is used as a control, and the growth rate is censored at the 95th percentile.¹²

¹² The inclusion of this dummy significantly increases the regression fit since much of the overall variance in the dependent variable is contained in these observations. All the regression specifications in Table 1 were re-run excluding these observations, and the estimated coefficients on the variables of interest changed little.

The broad bank health measures used here, and the fact that claims on emerging markets represent a relatively small part of the overall balance sheet for many banking systems, suggest that many types of shocks to bank health are exogenous from the perspective of individual borrower countries. Nonetheless, several estimation techniques are used to address potential endogeneity problems. Specifically, the above model is first estimated using ordinary least squares with various combinations of current and one-period lagged values of the explanatory variables, and then using instrumental variables regressions, taking one-period lags as instruments.

Empirical results

Claim growth reflects funding conditions ...

Consistent with the World Bank (2008) study, tensions in the global interbank market, as captured by increases in the TED spread, are associated with lower claim growth. The estimated coefficients on this variable are statistically significant and stable when the dependent variable is international claims (Table 1, columns 1–6). The coefficient estimates from model 6 suggest that a 10 basis point increase in the TED spread would lead to a roughly 1 percentage point reduction in the semiannual growth rate of international claims.

... bank health ...

The coefficients on the bank health indicators are of the expected sign and are statistically significant when international claims is the dependent variable. Higher bank equity returns and lower EDFs are associated with higher growth rates, and the statistical significance and magnitude of the coefficients change little across specifications. Model 6 implies that a rise of one standard deviation (roughly 30 basis points in the pooled sample) in banks' EDFs is associated with a 3 percentage point decrease in the semiannual growth rate of international claims. Similarly, a one standard deviation rise in banks' equity returns (roughly 17 percentage points) is associated with an 8.5 percentage point increase in the semiannual growth rate. In contrast to international claims, the coefficients on these regressors are statistically insignificant when the growth in local-in-local claims is used as the dependent variable.

... and measures of openness of the borrower country

The foreign bank participation rates also enter the regressions with the expected signs, and are generally statistically significant. Emerging markets with more open banking systems experience higher rates of growth in international claims, as evidenced by the positive coefficient on the overall rate of foreign bank participation in each borrower country (FBP overall). However, the negative coefficient on the banking system-specific participation rate (FBP specific) suggests that growth in credit from individual banking systems slows as their presence in the borrower country increases.

Other explanatory variables are (in some specifications) also important for both international and local-in-local claims. All else equal, a larger interest rate differential between the parent and borrower countries is associated with higher claims growth. In contrast, the measures of bilateral trade linkages generally do not enter significantly.

Bank health and lending to emerging markets¹

Sample period: Q1 1992 or earliest available for each country and banking system until Q2 2007

	International claims ²						Local-in-local claims ²	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 5	Model 6
TED spread	-0.0017***	-0.0011***	-0.0012***	-0.0011***	-0.0011***	-0.0008*	-0.0009	-0.0008
Bank equity returns	0.88***		0.55*	0.53*	0.52*	0.50*	0.32	0.66
Bank EDF		-9.60***	-9.37***	-9.60***	-9.68***	-9.98***	2.41	0.82
Bank asset volatility			-98.08	-99.52	-100.64	-129.38**	-213.66	-159.03
GDP growth (creditor)	-0.34	0.18	-0.35	-0.37	-0.37	-0.40	-0.28	-0.90
Lag GDP growth (creditor)	0.60*	-0.12	0.35	0.30	0.30	0.30	1.37***	1.69***
GDP growth (borrower)	0.28***	0.32***	0.29***	0.30***	0.30***	0.21***	0.43***	0.30**
Lag GDP growth (borrower)	0.01	0.18***	0.05	0.06	0.06	0.10	-0.29*	-0.24
Lag FBP overall				0.05	0.06*	0.07**	-0.11**	-0.10*
Lag FBP specific					-0.14	-0.26***	-0.15**	-0.11
Exchange rate change						-0.09***		-0.10***
Lag exchange rate change						0.00		0.06*
Real interest rate differential						0.01***		0.01***
Lag real interest rate differential						0.002		-0.001
Growth in imports						-0.01		0.01
Lag growth in imports						-0.01		0.02
Growth in exports						0.00		0.05
Lag growth in exports						-0.01		-0.01
R-squared	0.09	0.30	0.23	0.24	0.24	0.26	0.46	0.45
Number of obs	5,527	5,588	5,527	5,527	5,527	5,288	3,944	3,716

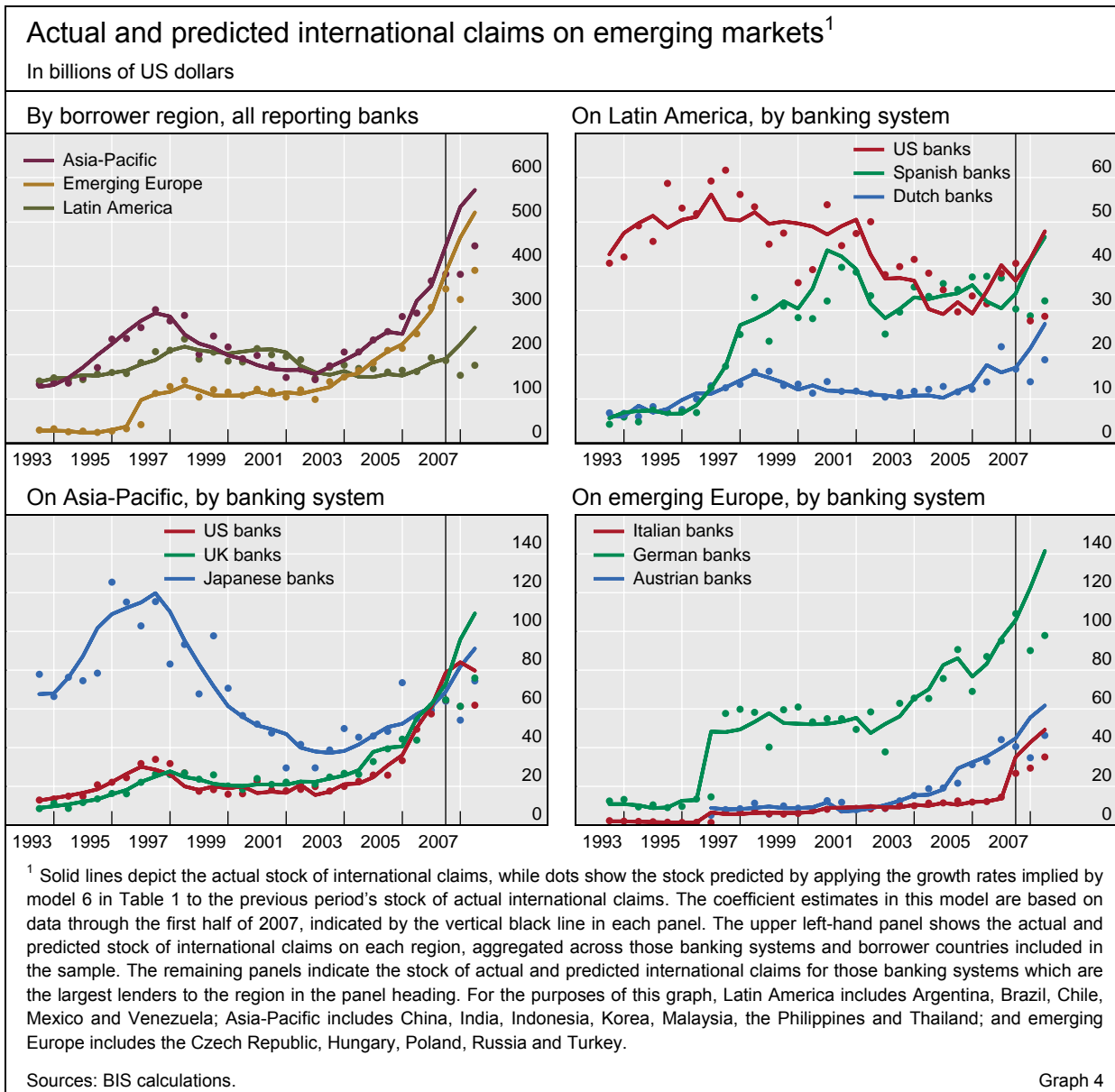
¹ One, two and three asterisks denote statistical significance at the 10%, 5% and 1% level, respectively. The TED spread, bank equity returns, bank EDFs and bank asset volatility are contemporaneous, but are instrumented with one-period lags. Regressions also include a lagged dependent variable, a full set of banking system dummies, borrower country dummies, a dummy for the first half of the year and dummy variables to capture bank mergers for three banking systems. The dependent variables are censored at the 95th percentile in the pooled sample, and each regression includes a dummy which is set to one when the censoring occurs. These dummies significantly increase the regression fit. ² Semiannual growth rates.

Table 1

Lending to emerging markets during the crisis

Credit to emerging markets remained robust through mid-2008 ...

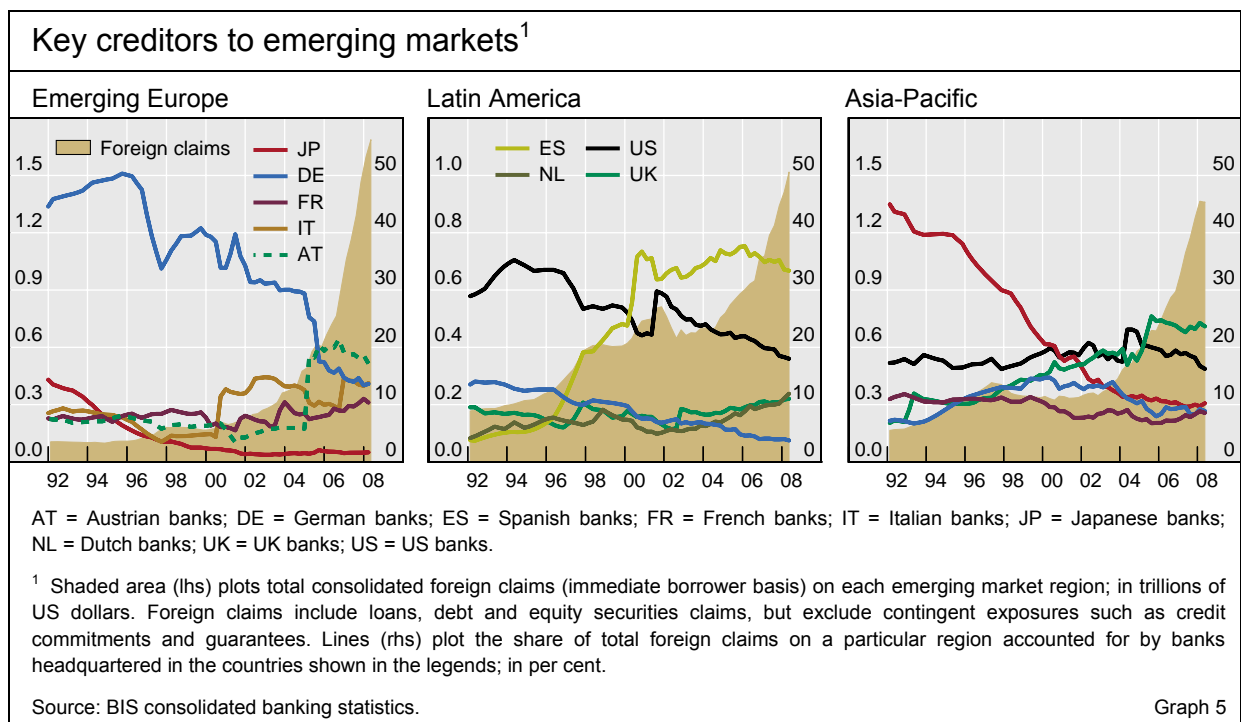
How well has bank credit to emerging markets held up during the recent period of financial crisis? Out-of-sample analysis on the basis of the panel regression coefficients reported in Table 1 can help answer this question. Specifically, the coefficients from model 6 are used to generate predicted growth rates both in- and out-of-sample, which are applied to the actual outstanding stock of international claims in the previous period. The results of this exercise are presented in the upper left-hand panel of Graph 4, where the solid lines show the actual level of international claims, and the dots of the same colour indicate their predicted level. In short, the two out-of-sample estimates (to the right of the vertical line) lie below the level of realised international claims for each of the emerging market regions, suggesting that credit to emerging markets has held up better than historical statistical relationships would imply.



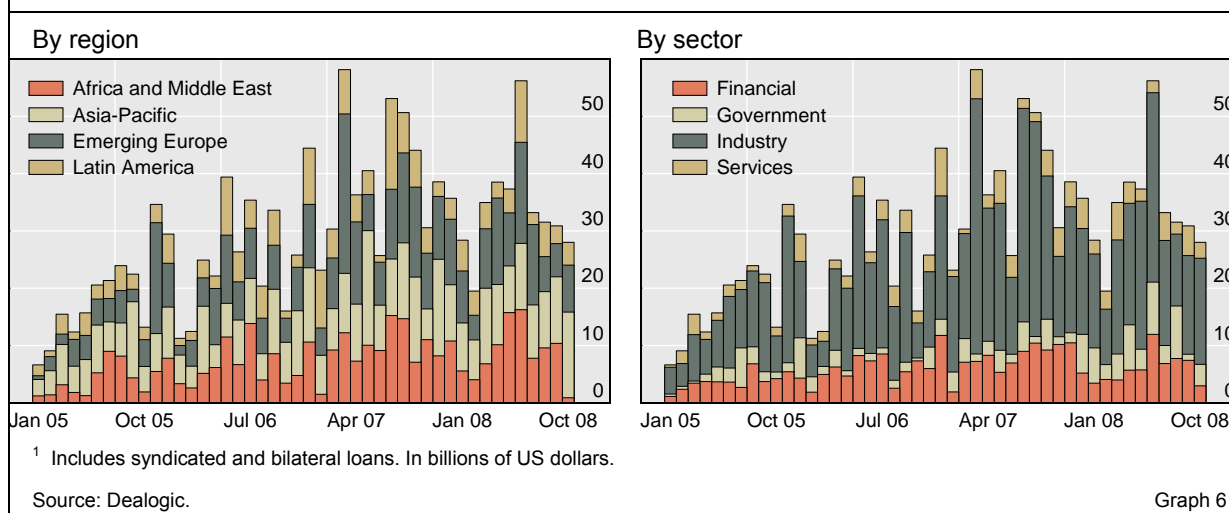
The banking systems which drive credit growth in a particular emerging market region differ significantly across regions (Graph 5). For example, Spanish and US banks are the largest foreign banks in Latin America, while Austrian, German and Italian banks are dominant in emerging Europe. Thus, one might expect that regions are affected differently by external shocks to bank health, depending on which banking systems are affected and dominant in a particular region. The remaining three panels of Graph 4 show banking system-specific actual and predicted international claims on each region. Again, the results show that credit growth has remained more robust than might have been expected.

That said, growth in international claims to emerging markets has already started to slow for several key banking systems. For example, the year-on-year growth in all BIS reporting banks' international claims on all emerging markets peaked at 34% in the second quarter of 2007, but subsequently dropped to 23% by the second quarter of 2008. While many banking systems reported a fall in growth rates, those of Austrian, Canadian, US and French banks decreased the most, but remained positive in each case. Data on signings of syndicated and bilateral international loans from Dealogic, available at a higher frequency and with a shorter lag, provide some evidence on lending activity through October 2008. As shown in Graph 6, the volume of signings of international loans to borrowers in emerging markets remained relatively robust during much of the crisis period, but has shown some signs, albeit tentative, of a slowdown in recent months.

... but signs of a slowdown have emerged



Signings of international loans to emerging markets¹



Conclusion

The results in this article point to a clear longer-term link between measures of bank health and the growth in foreign bank credit to emerging markets. Panel regression analysis indicates that, in the past, negative shocks to bank health were associated with slowdowns in credit growth. Despite the severity of the financial crisis, lending to emerging markets has held up relatively well through mid-2008, with lower but generally still positive growth rates. Whether the fundamental relationship between bank health and credit growth implied by the empirical model has changed in the most recent period of turmoil, or whether the deterioration in bank health will induce larger contractions in bank credit to emerging markets in the future, remains to be seen.

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How many in negative equity? The role of mortgage contract characteristics¹

An important precondition for mortgage default is that the borrower currently have negative equity, that is, that the mortgage balance be higher than the value of the property. This feature shows how sensitive the percentage of households in negative equity can be to different aspects of the mortgage contract. The recent large rise in mortgage delinquency and default rates in the United States, compared with the situation in other countries, can be partly explained by the fact that US mortgages were more likely to have characteristics that increased the incidence of negative equity.

JEL classification: G21, R21.

Households generally only default on their mortgages if they run into payment difficulty at the same time as they are in negative equity – that is, when the mortgage has a higher outstanding balance than the property's current value (less selling costs).² Households in negative equity cannot clear the debt completely by selling the property. While not sufficient to cause default, negative equity is thus an important precondition for it. In the current US housing bust, housing price falls leading to negative equity have been an important driver of early mortgage defaults (Haughwout et al (2008)). Recent private sector estimates reported in the *Wall Street Journal* (8 October 2008) suggest that as many as one in six US households are in negative equity and hence vulnerable to defaulting. It is therefore worthwhile to explore what factors are more likely to push a household or a pool of mortgages into negative equity.

Widespread negative equity can also have macroeconomic implications. Households which have fallen into negative equity but are still current on their

¹ This special feature was written while the author was on secondment to the BIS. The views expressed in this article are those of the author and do not necessarily reflect those of the BIS or the Reserve Bank of Australia. Any errors and omissions also remain those of the author, who would like to thank Ingo Fender, Goetz von Peter, Jacob Gyntelberg and Frank Packer for useful comments as well as Philippe Hainaut for assistance with the graphs.

² Previous literature shows negative equity alone is usually not sufficient to induce mortgage default: other trigger events – job loss, health problems or divorce, for example – are usually also necessary (Barth and Yezer (1983), Vandell and Thibodeau (1985), Deng et al (1996) and Diaz-Serrano (2005)). US data suggest that only around 10% of households that fall into negative equity actually default (Foote et al (2008)).

mortgage repayments are less likely to move to pursue other job opportunities, so labour market performance could deteriorate (Ferreira et al (2008)). This might be one of the drivers for the positive correlation seen between owner-occupation and unemployment rates in some countries (Oswald (1996, 1998)).

This special feature presents simulation results that quantify how much two aspects of the mortgage contract might affect the percentage of mortgage borrowers in negative equity: the rate at which principal is repaid (if at all), and how high the initial loan-to-value (LTV) ratio can be. The results help shed some light on why more US borrowers ended up in negative equity and experienced foreclosure in the early stages of the current US housing bust, compared with previous busts there and in other industrialised countries (Ellis (2008)). An unusually large fraction of new US mortgages originated in recent years did not require any principal to be paid down early in their lives: some were even negative amortisation loans where the loan balance could increase. Mortgages with high initial LTV ratios also became more common. Both developments represented an easing of lending standards, of a kind that was especially conducive to putting borrowers into negative equity.

The paper then shows that the effects of these particular means of easing lending standards were compounded by their distribution. Because many US households tend to refinance their mortgages frequently, a larger fraction of outstanding US mortgages is quite young and has therefore had little time to accumulate equity. Moreover, non-amortising and high-LTV mortgages were especially common in regions where housing prices were rising fastest, and have subsequently fallen the most. This concentration probably also boosted the incidence of negative equity in the United States.

In contrast, in many other countries where housing prices are now falling, negative amortisation mortgages apparently do not exist. High-LTV loans have long been available in countries such as the United Kingdom and the Netherlands, but remain relatively rare in these countries and others (Benito (2006)). These differences in mortgage financing might help explain why negative equity is estimated to remain lower in the United Kingdom (Bean (2008)) and other countries than in the United States, despite similar price falls.

The mechanics of negative equity and mortgages

An individual mortgage will end up in negative equity if the drop in housing prices from their peak exceeds the combined buffer of: (1) initial equity, which is determined by the LTV ratio; (2) the equity built up by housing price appreciation between the start of the mortgage and the peak of housing prices; and (3) any reduction in principal via repayment since the loan was taken out. This third element of the equity buffer depends on the amortisation method, which determines how quickly the principal is repaid.

Conventional *amortising* mortgages (also known as credit foncier or table mortgages) are the commonest type in the United States and most other industrialised economies. Repayments on these mortgages are a constant nominal amount depending on the initial amount borrowed, the per-period

Whether a mortgage ends up in negative equity partly depends on how fast it is paid down

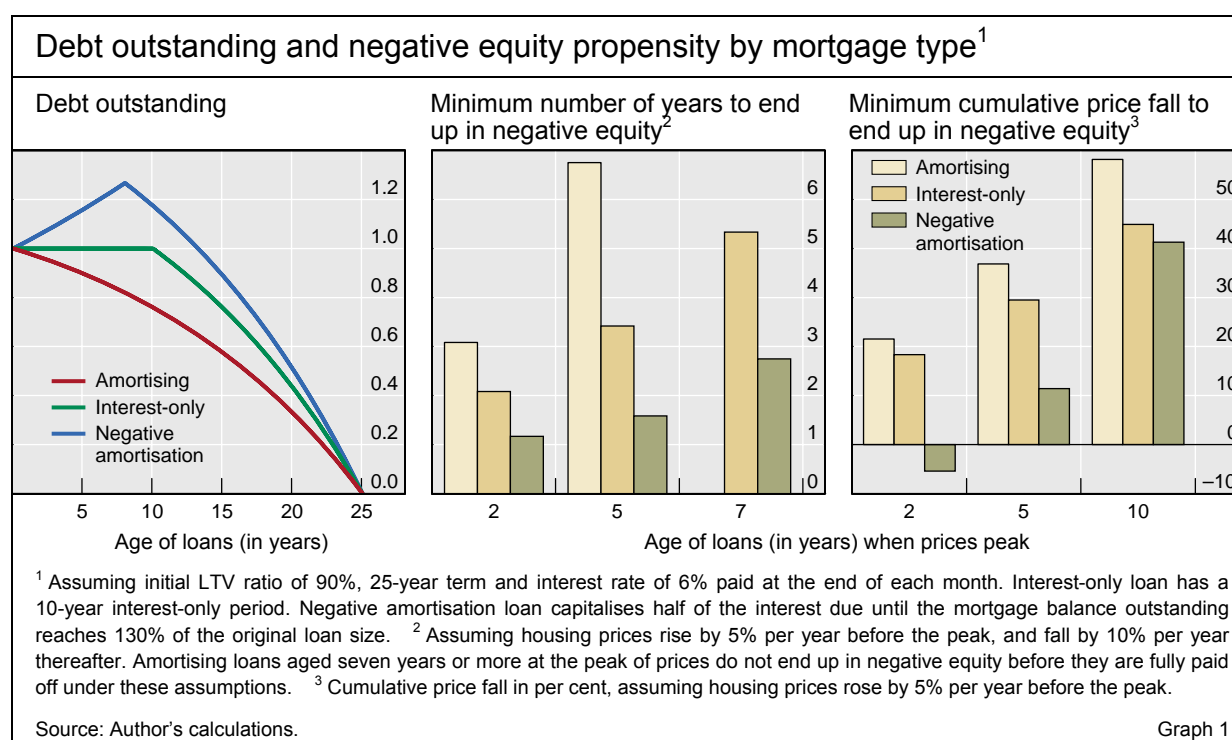
interest rate and the number of repayments. The remaining principal falls slowly at first, and then more quickly later in the life of the loan, as shown in the left-hand panel of Graph 1 (red line).

Some types of mortgages that became common in the United States ...

Interest-only (IO) and *negative amortisation* (NegAm) mortgages do not necessarily involve the repayment of principal in the early years of the life of the loan. Both types of mortgage were widely available in the United States in recent years; Edmiston and Zalneraitis (2007) cite industry data showing that these two types accounted for 7% of all US mortgages originated in 2004, and more than one quarter of those originated in 2006, at the peak of the price boom. In contrast, IO mortgages are relatively rare in most other countries that have experienced price booms of late, and NegAm mortgages are essentially unheard of.

... do not get paid down at first ...

A typical IO product available in the United States involves a 10-year IO period, after which the mortgage reverts to a conventional amortising form for the remaining term. The path of the outstanding debt is shown as the green line in the left-hand panel of Graph 1. NegAm mortgages (also known in the US context as option ARMs (adjustable rate mortgages) or pay-option ARMs) allow some of the interest to be deferred and added to the loan balance. Although borrowers could choose to make a larger, amortising payment, in the recent US episode it seems that most of them chose to pay the minimum and accumulate further debt. Once a prespecified threshold is reached, usually expressed as a percentage of the original loan size, the minimum repayment is recalculated (“recast”) and the loan reverts to an amortising form. The blue line in the left-hand panel of Graph 1 shows the path of the remaining principal, assuming a threshold of 130% of the original balance, and that half of the 6% interest due is capitalised.



The other panels of Graph 1 illustrate how important early-stage amortisation can be for the subsequent incidence of negative equity. Interest-only and NegAm mortgages, having less accumulated equity, will fall into a negative equity position sooner in a period of declining prices than a mortgage that amortises (centre panel), and they require a smaller overall decrease to do so (right-hand panel). If the outstanding balance has increased since the mortgage was first taken out, either because it is a NegAm loan or because it was subsequently refinanced with a large enough amount of cash taken out, negative equity can occur even if prices do not fall.

... and are therefore more likely to end up in negative equity

The aggregate incidence of negative equity

The preceding section shows that mortgages that do not amortise in their early years are more prone to forcing a home buyer into negative equity. Stagnant or declining prices also naturally work against the accumulation of positive equity. However, amortisation is a non-linear process. The implications of the mortgage contract's features for the aggregate incidence of negative equity – and thus vulnerability to default – must therefore be explored quantitatively.

The effects of different factors on negative equity are complex ...

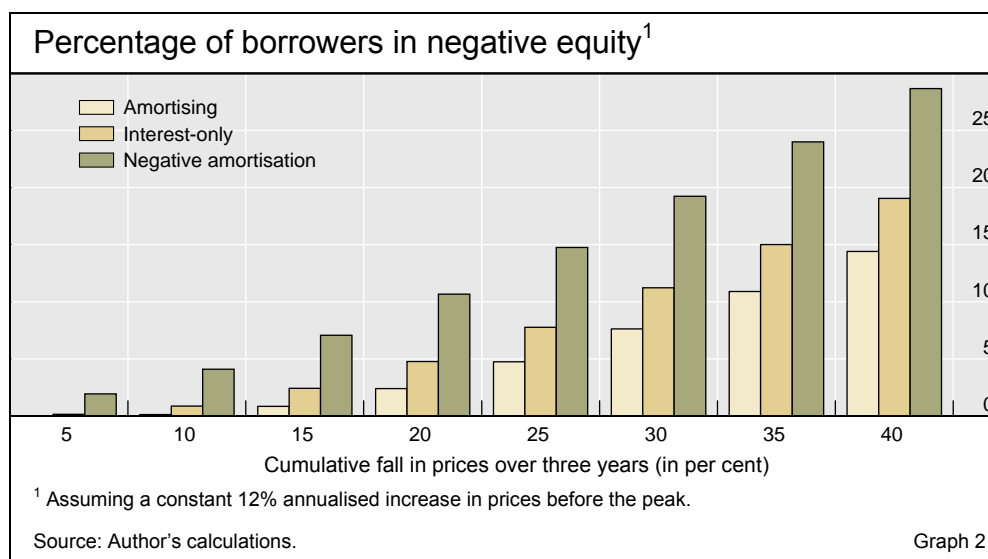
Graphs 2 through 5 show the aggregate consequences of different mortgage features for the incidence of negative equity in hypothetical populations of mortgages. A new cohort of borrowers is assumed to arrive each month and take out mortgages with a common term and interest rate. If their mortgages all have 25-year terms, as assumed here, there are 300 cohorts to keep track of. Different borrowers within each cohort have different initial LTVs, according to a certain distribution. Prices are assumed to rise and then fall on some prespecified path: the increased borrowing capacity enabled by some types of mortgage does not boost the upswing, and distressed sales by households in negative equity do not exacerbate the fall. In these examples, prices are assumed to fall continuously for three years, with the cumulative decrease shown along the horizontal axes of the graphs. This duration seems realistic given the length of the episodes of falling prices in Canada and the United Kingdom in the early 1990s; there are other episodes, however, such as the 1990s experience of Japan, where prices fell for longer periods.

... and must be analysed using numerical simulations

Amortisation type

Graph 2 illustrates how much difference the various mortgage amortisation methods make to the subsequent incidence of negative equity when prices drop. The bars show the percentage of borrowers falling into negative equity for different-sized decreases in housing prices, assuming that prices rose 12% per year in the upswing. This rate of growth is close to the increase in the Case-Shiller 20-city index during the boom phase of the recent US housing cycle. It is assumed that LTV ratios follow a distribution with a mean and a share of borrowers with LTVs above 95% similar to those for the actual distribution of initial LTVs of US mortgages originated in recent

Loans that are not paid down at first always end up in negative equity more often ...



years.³ Interest-only and negative amortisation loans have consistently higher incidences of negative equity than loans that amortise over their whole life. The effect is even more marked when the previous price growth is slower than 12%. For example, if prices rose 5% per year during the upswing, a 10% decline over three years would put more than 10% of NegAm mortgages into negative equity; only around 1% of IO mortgages and essentially none of the amortising mortgages would be in negative equity following a fall of that size.

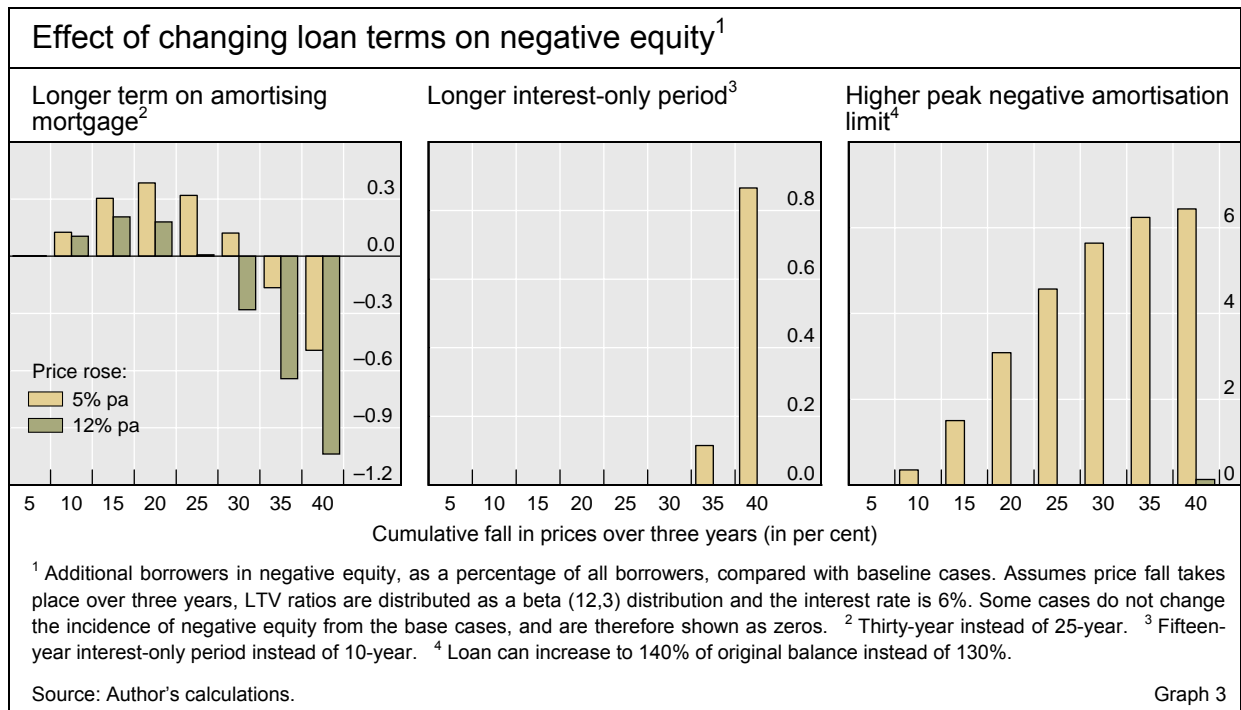
... but small changes to the amortisation arrangements make little difference ...

Within each mortgage amortisation type, varying the terms of the mortgage at the margin makes less difference than shifting between the amortisation types. Changing the term of an amortising loan, as shown in the left-hand panel of Graph 3, has two offsetting effects. Amortising the loan over a longer period implies that it is paid down more slowly. For any given age within the life of the longer loan, it will have a marginally higher loan balance than one paid down over a shorter term. Negative equity will therefore be slightly more common for young loans if the overall term is long.

Working against that effect, however, is that longer terms imply that there are more very old loans, with low balances and substantial equity built up through price appreciation. These additional borrowers can offset the first effect in very large downswings. The share of *households* in negative equity could still be higher, even though the share of *mortgages* is smaller. Presumably, if households pay down their loans over a longer term, fewer own their homes outright.

Extending the interest-only period on an IO mortgage to 15 years makes essentially no difference to the incidence of negative equity unless the fall in

³ Specifically, the results assume LTV ratios follow a beta distribution with shape parameters $\alpha = 12$ and $\beta = 3$, which has a mean of 80% and about 3% of borrowers with an initial LTV between 95 and 100%. Actual initial LTV ratios are not distributed as smoothly as this. As shown by Demyanyk and Van Hemert (2007) for subprime loans, there are usually spikes at round numbers such as 80%. Using a distribution such as the beta has the advantage that the incidence of negative equity can be calculated analytically. For actual pools of mortgages, the calculation would require splitting loans up into different buckets according to their LTV ratios. The different treatment does not bias the results, but does ignore the possibility that negative equity could in reality suddenly jump when these round-number thresholds are reached.



prices is extremely large; in those cases, the incidence of negative equity is a little higher than the base case of 10-year interest-only terms. The reason for this result is that only following very large price falls would the group affected by the change in loan terms – those with mortgages between 10 and 15 years in age – be close to a negative equity position.

Similarly, unless the rate of growth in prices before the peak was relatively slow (for example, 5% as shown in the graph), increasing the threshold ratio at which a NegAm mortgage recasts does not necessarily affect the incidence of negative equity, though the effect can be quite significant if it occurs. If borrowers can accumulate additional debt, more of them will end up with debt levels that can be overtaken by a subsequent price fall. However, this effect is dampened by the fact that it takes longer to reach the peak debt level, so the borrowers are also accumulating extra equity via housing price appreciation. A combination of a higher peak allowable debt ratio and a greater share of interest due being capitalised would result in a larger boost to the incidence of negative equity, since this would result in the peak ratio being reached faster.

... and in some cases, none at all

Initial loan-to-value ratio

The effect of the initial LTV on an individual loan's outstanding balance, and thus the susceptibility to negative equity, is directly proportional. However, the aggregate distribution of initial LTVs is not a uniform one, so any curvature of this distribution introduces a further non-linearity into the sensitivity of the aggregate incidence of negative equity to other loan features. The beta family of distributions, such as the one used to construct Graphs 2 and 3, is ideal for exploring this sensitivity: it is bounded between zero and one, and its density has a straightforward analytical expression.

High-LTV loans are more likely to end up in negative equity ...

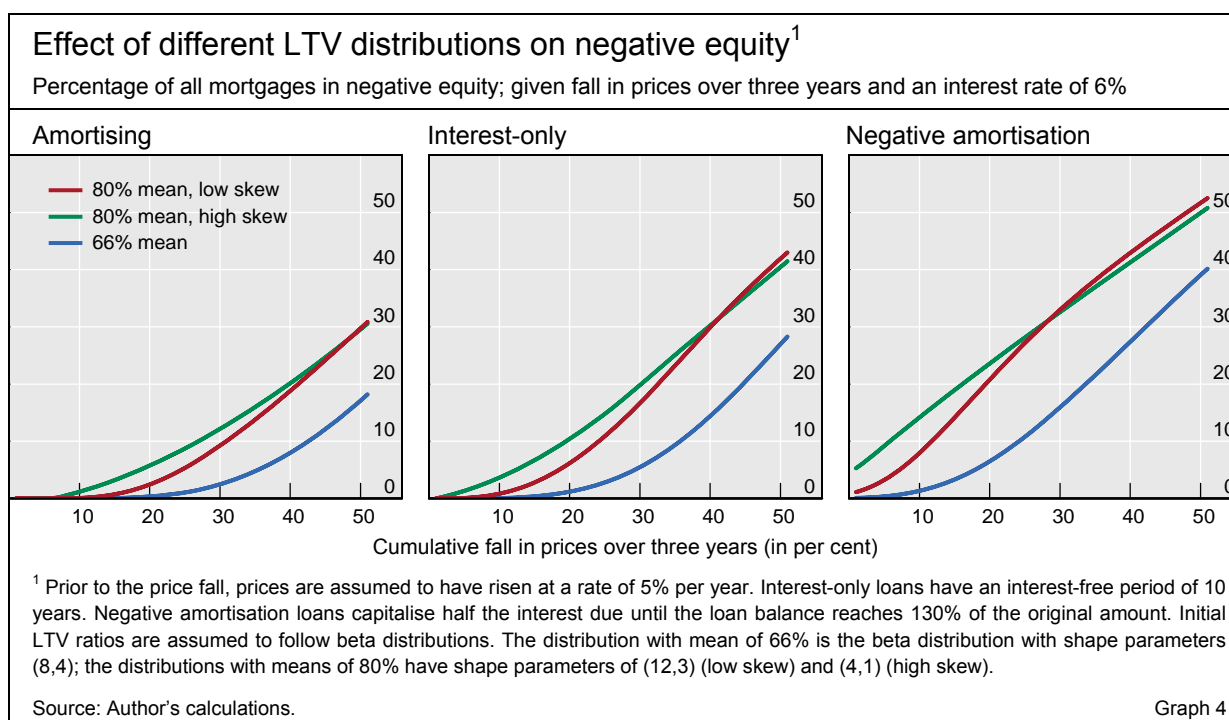
Graph 4 shows the implications for negative equity of different stylised LTV distributions. A lower average initial ratio (66%, similar to the actual

average for Australia in recent years), as represented by the blue line, clearly results in a lower incidence of negative equity.⁴ In fact, for small to moderately sized price falls, the incidence of negative equity amongst amortising or IO mortgages is essentially zero. It climbs steadily for distributions with a mean around 80% (the red and green lines), especially if the distribution is skewed to high values, as in the green line. The effect of increasing average LTVs is thus not linear in that average, but depends on the curvature of their distribution.

Although the two LTV distributions with the same mean have broadly similar implications for negative equity, there are still notable differences. By way of example, suppose that housing prices fell 15% over three years – not that different from some observers’ predictions for both the United Kingdom and the United States. Graph 4 implies that the incidence of negative equity in a pool of IO loans with the highly skewed distribution (green line) would be roughly double that in a pool of loans characterised by the less-skewed distribution (red line). For fully amortising loans, the sensitivity is even starker: only the highly skewed distribution shows a significant fraction of loans in negative equity for price falls of this size.

... and they became more common in the United States in recent years

The practical relevance of these results for explaining recent history is clear. As reported by Demyanyk and Van Hemert (2007) for subprime loans and Ashcraft and Schuermann (2008) more generally, average LTVs on US mortgages increased noticeably over the 2000s housing boom period, and the



⁴ The figure for the weighted average LTV in Australia was calculated from the average loan size of newly approved housing loans (excluding refinancing), from Table 1 of the June 2008 release of ABS Cat No 5609.0 (www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5609.0Jun%202008?OpenDocument), and a weighted average of house and apartment prices obtained from the Commonwealth Bank's Property Value Guide (www.pvg.webcentral.com.au/propertyValueGuideChart.asp), accessed 6 August 2008.

share of new loans with high LTVs (close to or even above 100%) rose. Both shifts would have raised the vulnerability of the US mortgage book to falling into negative equity.

Another factor that could cause sharp jumps in the incidence of negative equity is that mortgages are more likely to have initial LTVs of a round number (eg 80% or 85%) than a fractional amount. This generates spikes in the empirical distribution of LTVs, for example as shown in Demyanyk and Van Hemert (2007). It also implies that there would be discontinuities in the incidence of negative equity, the further prices fall.

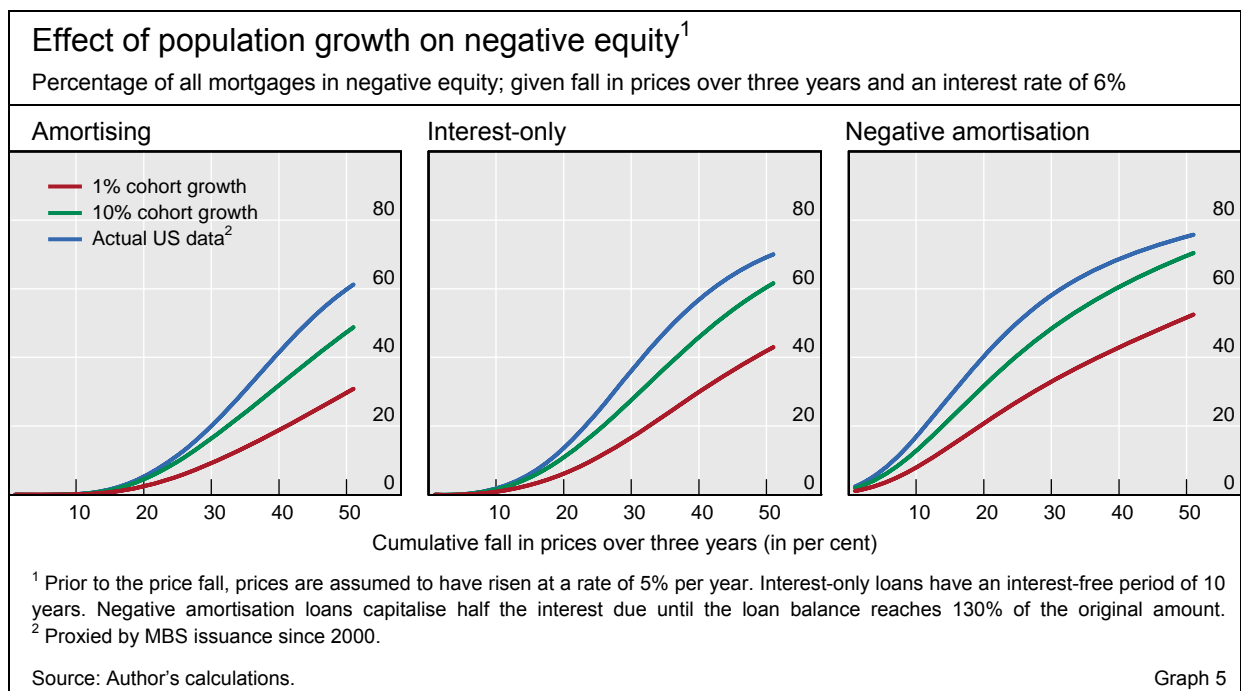
Age of the mortgage book

The US mortgage market is characterised by relatively frequent refinancing compared with the markets in many other countries (Tsatsaronis and Zhu (2004)). Many subprime mortgages were effectively designed to be refinanced frequently (Gorton (2008)). Thus it seems probable that more US mortgage borrowers would be likely to fall into negative equity, for any given drop in housing prices, because their mortgages are quite young.

Many US loans were quite new ...

Graph 5 provides some quantitative intuition for the importance of this effect. As in the previous simulations shown in Graph 4, housing prices are assumed to increase at an annual rate of 5% per year, before falling for three years, resulting in a cumulative decrease shown on the horizontal axis of each panel of the graph. There is a new cohort of borrowers each month. For the red line, each monthly cohort is assumed to be 1% larger than the cohort that took their mortgages out one year previously; for the green line, the annual growth rate of the cohort size is set at 10%.

The blue line in Graph 5 is intended to show the possible result when the fall in prices has been preceded by a refinancing boom, such that the population of loans is bunched in the youngest cohorts. This is done by assuming that the borrower cohort sizes increase at an annual rate of 2% for



the first 16 years of history, and then follow the actual path of US mortgage origination volumes since 2000, as proxied by MBS issuance over that period.⁵ The resulting profile of cohort sizes has a large bulge of recent borrowers. Low mortgage interest rates during 2003 and 2004 encouraged US households to refinance their mortgages, with the result that 45% of households with a first mortgage had refinanced within the three years up to 2004 (Bucks et al (2006)).

... which also boosts the incidence of negative equity, especially where prices have fallen a long way

The results show that either a faster average growth rate in the number of borrowers or a bulge of recent borrowers raises the incidence of negative equity. However, the difference is only quantitatively important for large falls in prices. Even so, prices have fallen by more than 20% from their peaks in some US cities, notably those in the states of California, Nevada, Arizona and Florida. Many of the cities were attracting new residents in recent years, so the bulge of recent borrowers there is probably even larger than the national average. It is therefore likely that the age profile of mortgages tended to boost the incidence of negative equity in these cities relative to the national average.

Concentration effects

The above results have outlined a number of factors likely to increase the incidence of negative equity in a population of mortgages. These include the use of negative amortisation mortgage products, a sizeable fraction of borrowers with initial LTV ratios at or near 100% and a concentration of borrowers having taken their loans out recently. Unless the price fall is large, though, other details of the mortgage contract have less effect.

A regionally concentrated bust would make negative equity more common ...

Two other factors probably boosted the incidence of negative equity in the United States beyond either the results presented above or the experience of other countries. First, the decline in housing prices in the United States was quite concentrated in a few states. Averaging across the results in Graph 2 implies that the incidence of negative equity will be higher when the fall in housing prices is skewed to a few centres. For example, for a pool of IO mortgages that experienced 5% annual housing price growth in the upswing, the incidence of negative equity would be 3.7% after a 15% price fall over three years. If instead half the mortgages experienced a drop of 10% and the other half 20%, the aggregate incidence of negative equity would be 4.6%. This could be partly offset by the fact that the cities that experienced the greatest decreases were generally also the ones that earlier had the strongest increases. However, alternative scenarios using different assumptions for price rises and falls imply that past price growth matters little beyond some point: most of the mortgages that end up in negative equity are fairly young and have therefore not had much time to experience any housing price appreciation.

... as would the geographical distribution of certain mortgage products

Second, it is well known that the regional booms in housing prices in the United States went hand in hand with increased usage of so-called “affordability” mortgage products, including IO and NegAm products as well as

⁵ The monthly cohort sizes were interpolated from the annual MBS issuance data using the Ginsburgh procedure to ensure that the total monthly cohort sizes added up (in relative terms) to the annual totals.

those with high initial LTVs. For example, the *Financial Times* reported (2 September 2008) LoanPerformance data showing that more than half of all US option ARMs (ie NegAm loans) were for property in California, where the boom and bust in prices were especially large. Comprehensive long-run data on the share of IO and NegAm mortgages by age cohort and geographical region in the outstanding mortgage book (as opposed to new originations) are not available. As an illustrative example, though, suppose California's share of NegAm loans had been 30%, rather than the 10% share of all recent mortgages as reported in Edmiston and Zalneraitis (2007). This would have boosted the incidence of negative equity by nearly 3 percentage points, from 8.2% to 10.9%.⁶ The curvature of the results in Graph 4 likewise makes it clear that if LTV ratios are highest in cities where prices subsequently decrease the most, the incidence of negative equity will be higher than if LTVs and price falls were more evenly distributed.

Implications for cross-country comparisons and credit losses

The simulations presented in this special feature explored the quantitative implications of different loan types and housing price outcomes for the incidence of negative equity amongst home mortgages. These exercises were completely mechanical, with no behavioural content. In particular, they did not allow for prepayment, moving or refinancing. Nonetheless, the results pinpoint the kinds of mortgages that are more likely to fall into negative equity, which is in turn an important precondition for mortgage default.

The relationships between the characteristics of mortgages and the incidence of negative equity in a housing bust help explain why US households have fallen into negative equity in greater numbers, and experienced more financial distress, than might have been expected from past experience in the United States and elsewhere. US households were more likely to take out high-LTV loans, and loans with interest-only or negative amortisation features, than seems to have been the case in other countries. The refinancing boom of 2003–04, as well as the frequent refinancing embedded in subprime mortgage contracts (Gorton (2008)), meant that an unusually large fraction of US mortgages was quite young, and had built up little equity since origination. In addition, the regional concentration of both the boom and the bust in prices probably added to the incidence of negative equity in the early stages of the bust.

Estimating the actual incidence of negative equity is complicated by the possibility of transactions at fire sale prices. Housing is heterogeneous and in some neighbourhoods the market will be quite thin. Borrowers that suddenly find themselves in financial difficulty might only be able sell quickly at much-

Some kinds of mortgage products increase the incidence of negative equity ...

... which helps explain why it became so common in the United States

It is difficult to know if a particular individual mortgage is in negative equity ...

⁶ This hypothetical scenario rests on calculations similar to those presented in Graph 2, assuming that prices rose steadily before the peak at an annual rate of 10%, and dropped 28% thereafter. This is close to the actual falls from their peaks up to June 2008 in the Case-Shiller indices for Los Angeles, San Diego and San Francisco.

reduced prices. Until the property actually comes up for sale, it can be difficult to be sure that it is indeed in negative equity.

... or predict what that means for lenders' credit losses

These simulation results provide some information about the extent of mortgage lenders' probable credit losses, but they should not be over-interpreted. It would be tempting to assume that losses would be proportional to the aggregate incidence of negative equity. However, given negative equity, some borrowers are more prone to default than others. The recent US experience suggests that those most likely to default are the same ones that were more likely to choose mortgages with features that made them most susceptible to falling into negative equity. Interest-only and negative amortisation mortgages seem to have been chosen in greater numbers by the more marginal borrowers, perhaps because they were excessively focused on the affordability of the initial repayment.

Loan losses also depend on the sizes of loans that default ...

In addition, because negative equity and defaults are liable to be concentrated in newer loans and those with negative amortisation features, they are also likely to be concentrated amongst larger loans. The simulations reported here focus on the incidence of negative equity by number of loans; when considering loan losses, incidence by value would be a more relevant metric. The figures reported here should therefore be considered a lower bound on the vulnerability of a given loan book to default.

... and the likelihood that mortgages in negative equity actually default ...

Finally, cross-country variation in the incidence of negative equity need not translate one for one into the incidence of actual default. Many other factors make borrowers more or less likely to actually default when in negative equity. Previous literature shows that households usually only default on their mortgages if they experience a shock that disrupts their ability to pay. Probabilities of default therefore depend on how frequently those shocks occur, what the penalties for default are, and whether households have other resources they can draw upon to help withstand those shocks.

... which in turn depends on a range of institutional factors

Households in negative equity might be more likely to actually default in the United States, for example, because unexpected health care cost shocks could disrupt their finances in ways that occur less often in countries with other health insurance arrangements (Bernanke (2008)). If a country has a greater rate of churn in its labour market than others, it might also imply that more households face the negative income shock of job loss, for any given unemployment rate. The availability of mortgage payment insurance or other resources to help households withstand income shocks could also affect the propensity for negative equity to translate into actual defaults.

The upsurge in arrears and default rates on US mortgages in recent years had many interrelated causes (Ellis (2008)). Institutional factors that made households in negative equity more prone to default were clearly one set of contributing factors. Perhaps more important, though, is that the types of mortgages on offer in the United States were more likely to have features conducive to pushing the borrower into negative equity if housing prices subsequently fell.

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