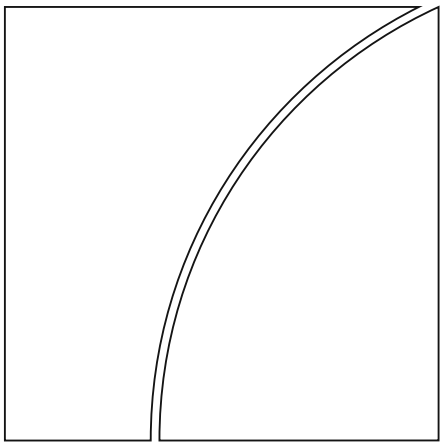
BANK FOR INTERNATIONAL SETTLEMENTS

BIS Quarterly Review

March 2013



International banking and financial market developments

BIS Quarterly Review
Monetary and Economic Department

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Special features

Notations used in this Review

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

Differences in totals are due to rounding.

The term “country” as used in this publication also covers territorial entities that are not states as understood by international law and practice but for which data are separately and independently maintained.

Markets grow confident on continued support[1]

Extensive policy support has infused financial markets with a renewed sense of optimism over the last few months. Continued weakness in economic fundamentals led to extended accommodation in the form of monetary easing and a moderation in the pace of near-term fiscal consolidation. The resulting fall in perceived downside risk buoyed financial markets and drove investors into riskier asset classes. Safe haven flows ebbed as funds poured into equity and higher-yielding debt instruments, including those in emerging markets and the euro area periphery. These developments supported a renewed sense of optimism in financial markets with which macroeconomic performance has yet to catch up.

Financial markets rally ahead of economic fundamentals

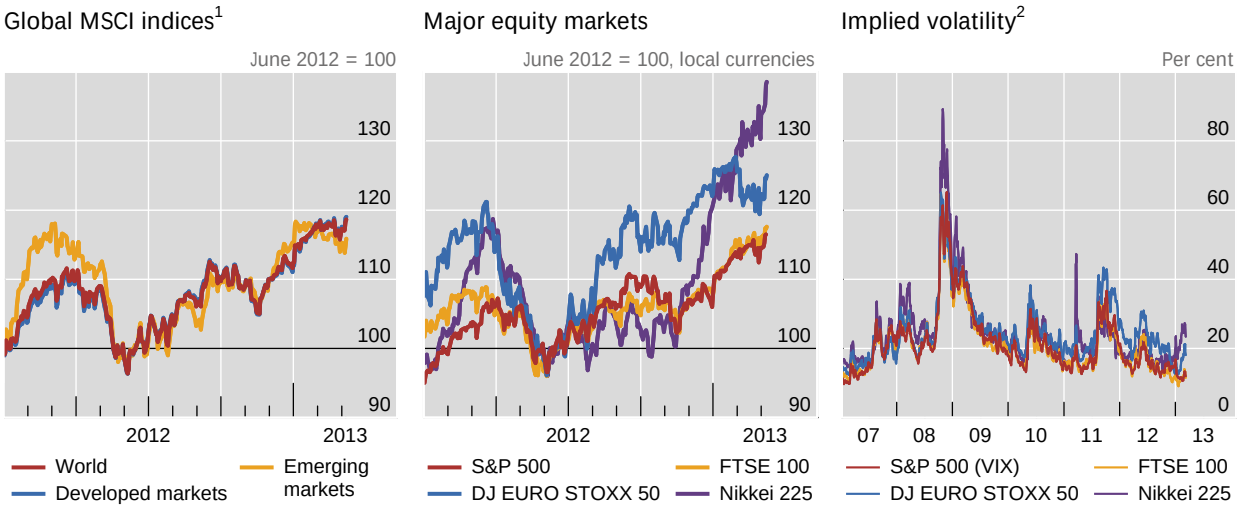
As the new year started, the asset valuation gains of the previous months continued. The global equity index has gained 5% since early January, and 23% since the low reached in June 2012 when the euro area crisis was still in full swing and global growth appeared to be faltering (Graph 1, left-hand panel). The trend in the major equity markets had gathered momentum in November, triggering a rally in January (Graph 1, centre panel). Throughout this time, volatility in most major equity markets gradually declined, eventually reaching its lowest level since May 2007 (Graph 1, right-hand panel) in a sign that market participants regarded sharp market movements as less likely going forward.

By limiting perceived downside risks, policy accommodation played a central role in these developments. Risk reversals, an option-based measure of tail risk, declined substantially in response to central bank announcements (see box). And the cost of insurance protection against an equity market drop fell most sharply in July and September 2012 in response to key ECB announcements, and again in early January following the US "fiscal cliff" deal (Graph 2, left-hand panel). Mitigation of downside risks was also reflected in debt and currency markets. Yields on US Treasuries and German government bonds, often viewed as safe havens in times of elevated uncertainty, rose in January with no commensurate rise in inflation

[1] This article was prepared by the BIS Monetary and Economic Department. Questions about the article can be addressed to Masazumi Hattori (masazumi.hattori@bis.org) and Goetz von Peter (goetz.von.peter@bis.org). Questions about data and graphs should be addressed to Agne Subelyte (agne.subelyte@bis.org).

Global equity prices and volatility

Graph 1



[1] Free float-weighted equity indices, in US dollars. [2] Five-day moving averages.

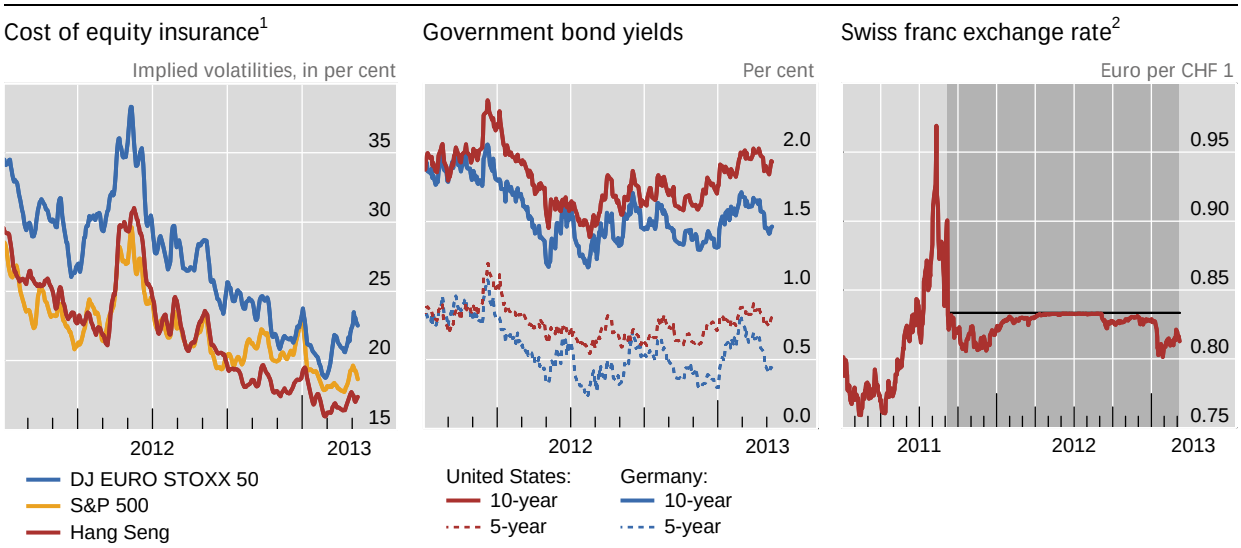
Source: Bloomberg.

expectations (Graph 2, centre panel). Similarly, the preference for the Swiss franc as an alternative to the euro waned for the first time since 2011. The exchange rate between these two neighbouring currencies moved away from the ceiling of CHF 1.20 to the euro set by the Swiss National Bank (Graph 2, right-hand panel).

Financial markets rallied even as growth data were signalling continued macroeconomic weakness in the advanced economies. The United Kingdom and the euro area suffered a contraction in 2012, while the United States experienced

Equity insurance and safe havens

Graph 2



[1] Premiums for insurance against a decline in the equity index of 10% or more, relative to three-month forward prices, quoted as the implied volatilities that map to these premiums via the Black-Scholes option pricing formula. Higher implied volatilities correspond to higher premiums. [2] The horizontal line represents the ceiling on the Swiss franc's value in euro terms (1/1.2 = 0.83) that the Swiss National Bank has enforced since 6 September 2011 (represented by the shaded area) by means of foreign exchange intervention.

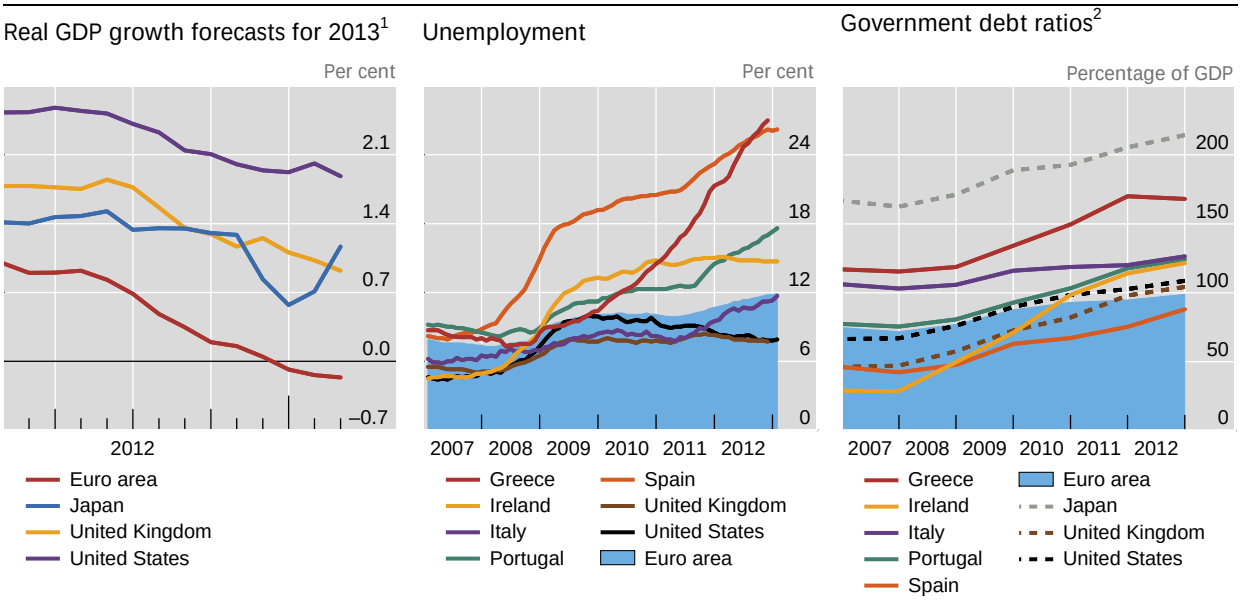
Sources: Bloomberg; Datastream.

subdued growth. Indeed, in the OECD as a whole, GDP shrank in the fourth quarter as Germany and France ended the year with a dip. Southern Europe, entering the fourth year in or close to recession, was expected to contract further in 2013. In contrast to improving financial market conditions since mid-2012, quarterly growth rates in many countries were gradually falling and so were growth forecasts for 2013 (Graph 3, left-hand panel). An exception to this trend was Japan recently, where the anticipation of expansionary policies fuelled growth expectations. The evolution of expected corporate profits conveys a similar impression. In the course of 2012, forecasts of earnings per share saw successive downward revisions in the United States and weak upward revisions in the euro area.[2] This suggests that improved fundamentals were not the main factor underpinning the recent equity market rally.

Renewed optimism in financial markets over the last few months mainly hinged on continued policy accommodation, reinforced by a few upside data surprises. The Citigroup Economic Surprise Index showed that news releases began to outperform expectations in September on average, but in Europe only as from January. Hopes for global growth also ticked up following trade and purchasing managers' index (PMI) releases that surprised on the upside. Even so, PMI data in many advanced economies reflected a contractionary environment with readings below the neutral level of 50, with the exception of the US PMI pointing to a modest expansion. By comparison, emerging markets showed more robust growth, boasting consensus forecasts of 3.5% for Latin America, 2.7% for eastern Europe and 4.8% for Asia, with China avoiding a much feared slowdown.

Fundamentals and government debt

Graph 3



[1] Consensus forecasts from survey of each month. [2] General government gross financial liabilities.

Sources: IMF, *World Economic Outlook*; OECD; © Consensus Economics; Eurostat; national data.

[2] These observations were based on earnings per share forecasts for firms included in the MSCI EMU Index and S&P 500 Composite Index, available at I/B/E/S.

Tail risk perceptions around unconventional monetary policy announcements

Masazumi Hattori, Andreas Schrimpf and Vladyslav Sushko

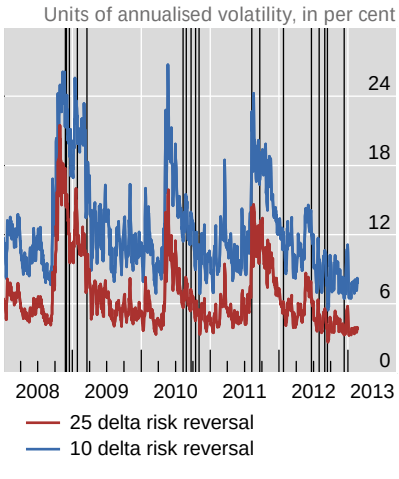
Unconventional policy actions by various central banks over the past few years are perceived to have helped (at least partly) alleviate some of the most immediate downside risks to financial markets and the global economy.① Any evidence on what may be labelled the "tail risk impact" of unconventional monetary policy has, however, largely been anecdotal. In this box, we present quantitative evidence which suggests that announcements related to unconventional monetary policy measures substantially reduced market perceptions of tail risks. Hence, the impact of these policies may in fact have been broader than suggested by existing studies, which focused on the effects of quantitative easing (QE) on the shape of the yield curve, asset prices more broadly and portfolio flows.

We gauge downside risk perceptions using information gleaned from option prices. Specifically, we rely on the difference between the option-implied volatilities of out-of-the-money (OTM) puts and OTM calls of the same maturity and "moneyness" (or so-called delta), often referred to as "risk reversal".② An OTM option has a strike price distant from the current market price and thus will only be exercised if the price movement over the option's lifetime is sufficiently large. Since equity returns are typically negatively skewed, ie steep price falls are more likely than steep rises, OTM puts are more likely to be exercised than OTM calls. As a result, the price of OTM puts (or, equivalently, their implied volatility) is higher. This is further compounded when investors may expect large losses, consequently demanding high risk premia to compensate them for such tail events. The difference in the two implied volatilities is thus magnified in stress episodes when hedging costs against downside risk are particularly elevated (Graph A, left-hand panel). Therefore, risk reversals can be an informative indicator of how market participants perceive the risk of a severe stock market crash. This differs from the VIX, a commonly used "fear gauge", which does not specifically capture downside risks, as it is a symmetrical measure of expected volatility.③

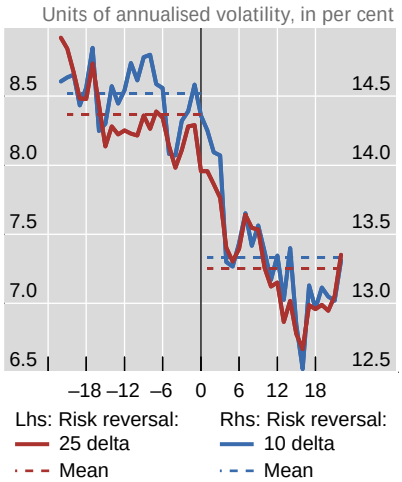
To capture the impact of unconventional monetary policy on risk reversals, we compare their levels over an event window of several trading days before and after key announcements. The tail risk measures dropped by 10% on average around 18 unconventional monetary policy announcements by the US Federal Reserve (Graph A, centre

Fed unconventional monetary policy announcements and pricing of tail risks — Graph A

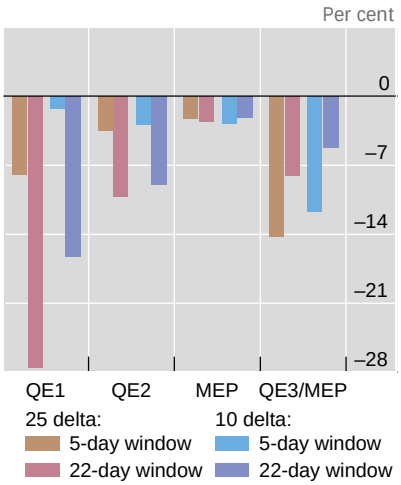
S&P 500 risk reversals and Fed announcements[1]



Average reaction around Fed announcements



Relative 5- and 22-day changes during different policy phases



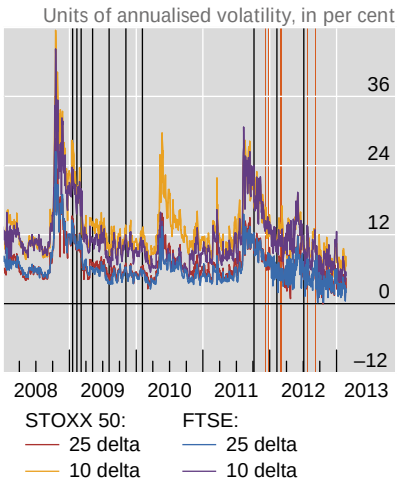
[1] The vertical lines indicate Fed asset purchase and "forward guidance" announcements and related speeches. First two phases of Large-Scale Asset Purchases by the Fed (QE1 in 2008–09 and QE2 in 2010): 25 November 2008, 1 December 2008, 16 December 2008, 28 January 2009, 18 March 2009, 10 August 2010, 27 August 2010, 21 September 2010, 15 October 2010 and 3 November 2010; Maturity Extension Program (MEP, since September 2011): 9 August 2011, 21 September 2011, 25 January 2012, 20 June 2012 and 1 August 2012; and the ongoing open-ended monthly purchases of Treasuries and agency mortgage-backed securities (QE3/MEP, since September 2012): 31 August 2012, 13 September 2012 and 12 December 2012.

Sources: Federal Reserve; Bloomberg; authors' calculations.

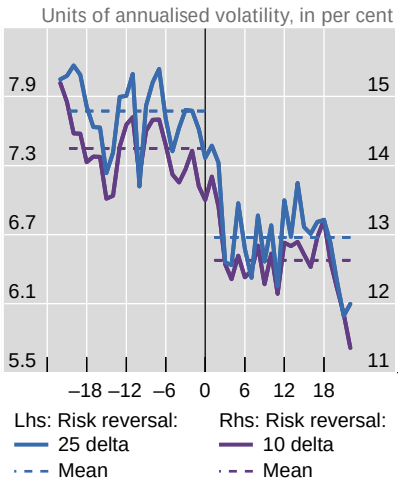
BoE and ECB announcements and pricing of tail risks

Graph B

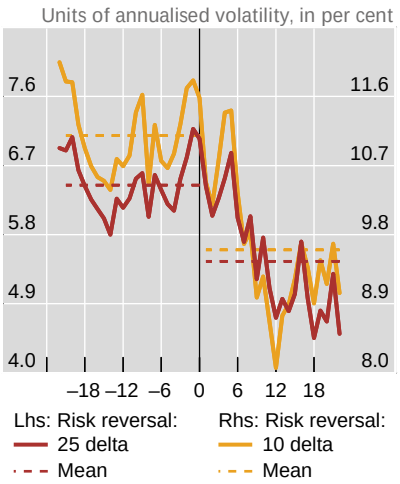
FTSE 100 and DJ EURO STOXX 50 risk reversals and BoE and ECB announcements[1]



Average reaction around BoE announcements



Average reaction around ECB announcements



[1] The black vertical lines indicate BoE asset purchase announcements and related speeches: 19 January 2009, 11 February 2009, 5 March 2009, 7 May 2009, 6 August 2009, 5 November 2009, 4 February 2010, 6 October 2011, 9 February 2012 and 5 July 2012; the red vertical lines indicate ECB announcements and speeches related to three-year LTROs and OMTs: 8 December 2011, 21 December 2011, 29 February 2012, 26 July 2012 (first trading day after previous evening's announcement) and 6 September 2012 (first trading day after previous evening's announcement).

Sources: ECB; Bank of England; Bloomberg; authors' calculations.

panel). As the graph shows, there is an immediate drop of risk perceptions following the announcements and the effect is sustained for some time, with risk reversals on average lower at five-day and longer horizons.④

Risk perceptions were affected more strongly during the first round of unconventional policies, especially around QE1 announcements (Graph A, right-hand panel). The impact of subsequent announcements associated with QE2 and early phases of the Maturity Extension Program (MEP) was more subdued. Fed announcements appear to have been curbing tail risk perceptions once again during the ongoing phase of QE3. The resumption of a stronger impact of Fed announcements may be best understood by appealing to a framework whereby central bank purchases can provide insurance against tail events, if accompanied by clear communication and a commitment to condition policy actions on future states of the economy.⑤ Hence, the Fed's use of "forward guidance" and the communication of employment targets for asset purchases may have enhanced the effect of MEP and of QE3.⑥

Announcements by other central banks may have reduced tail risk perceptions as well. Asset purchase announcements by the Bank of England (BoE) had qualitatively similar effects (Graph B, centre panel). The more sluggish reaction to the recent ECB announcement suggests differences in the transmission of ECB policies, namely three-year longer-term refinancing operations (LTROs) and outright monetary transactions (OMTs), as compared with outright asset purchase announcements by the Fed and the BoE (Graph B, right-hand panel).

① See eg Olivier Blanchard, "(Nearly) nothing to fear but fear itself", *The Economist*, 29 January 2009; speech by Fed Chairman Ben Bernanke at the Jackson Hole Symposium, 31 August 2012; and BIS, *82nd Annual Report*, June 2012. ② The delta of an option measures the sensitivity of its price to changes in the price of the underlying. Lower delta options (eg 10 delta) have a strike more distant from the current price and are thus deeper OTM options. ③ We report absolute values of risk reversals, such that a higher value corresponds to a higher price of crash risk insurance. ④ In M Hattori, A Schrimpf and V Sushko, "The response of tail risk perceptions to quantitative easing", 2013, mimeo, we conduct some more detailed analysis. Based on a bootstrap approach, we find that changes in risk reversals around Fed announcement dates are statistically significant, with effects stronger relative to simple volatility measures. We also control for other factors driving risk perceptions using event study regressions and examine the effects of actual asset purchases in structural vector autoregression frameworks. ⑤ See M Brunnermeier and Y Sannikov, "Redistributive monetary policy", paper prepared for the 2012 Jackson Hole Symposium. ⑥ The mechanism may operate by improving the capital position of value-at-risk (VaR)-constrained financial institutions, as Fed purchases affect the market value of their fixed income and possibly other asset holdings. A lower likelihood of hitting the VaR constraint may lead to repricing of risks and raise risk appetite, as in H S Shin, *Risk and liquidity*, Oxford University Press, 2010. See also C Borio and H Zhou, "Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism", *BIS Working Papers*, no 268, December 2008, for a discussion of monetary policy transmission via financial intermediary balance sheets and risk spreads.

The underlying economic weakness in the advanced economies added to fiscal strains and triggered further ratings downgrades. UK government debt lost its AAA rating from one agency on the view that the sluggish growth environment posed an increasing challenge to the government's fiscal consolidation efforts. This left only Canada and Germany with the top rating from all three main rating agencies among the G8 countries. As with France's downgrade in November, the ratings action was anticipated and the market response subdued. At the same time, economic conditions continued to exert pressure on public finances from both the revenue and expenditure sides. While official unemployment in the United States, the United Kingdom and Ireland had turned, the jobless rate continued to rise in many other advanced economies (Graph 3, centre panel). In Greece and Spain, unemployment breached 25% (50% for youth up to 24 years of age), illustrating the depth of their recessions. Since GDP was growing more slowly than government debt in many countries, their public debt burdens continued to rise in spite of fiscal consolidation efforts (Graph 3, right-hand panel). That said, the Greek debt burden benefited from earlier cuts and a debt buyback programme in December, resulting in a rare ratings upgrade.

Macroeconomic weakness leads to broader easing

Market participants reacted with growing optimism to a range of policy measures taken to support the fragile economic recovery. On the fiscal side, a number of short-term consolidation measures were postponed or eased. US lawmakers averted the fiscal cliff in late December that had threatened to induce a recession in 2013. The combined tax hikes and spending cuts equivalent to 5% of GDP gave way to a more moderate deficit reduction by automatic "sequester" budget cuts, resulting in $42 billion less spending up to September 2013 by Congressional Budget Office estimates. This boosted equity markets in early January, as did the temporary suspension of the statutory debt limit later that month. Also in January, Japan's new government turned its campaign promise into a stimulus package of ¥10 trillion to boost growth and overcome deflation, and the markets rallied with little concern over Japan's debt burden. The administration's ¥13 trillion supplementary budget containing the stimulus package was largely debt-financed, with 51% of the additional spending not being matched by planned tax revenue.

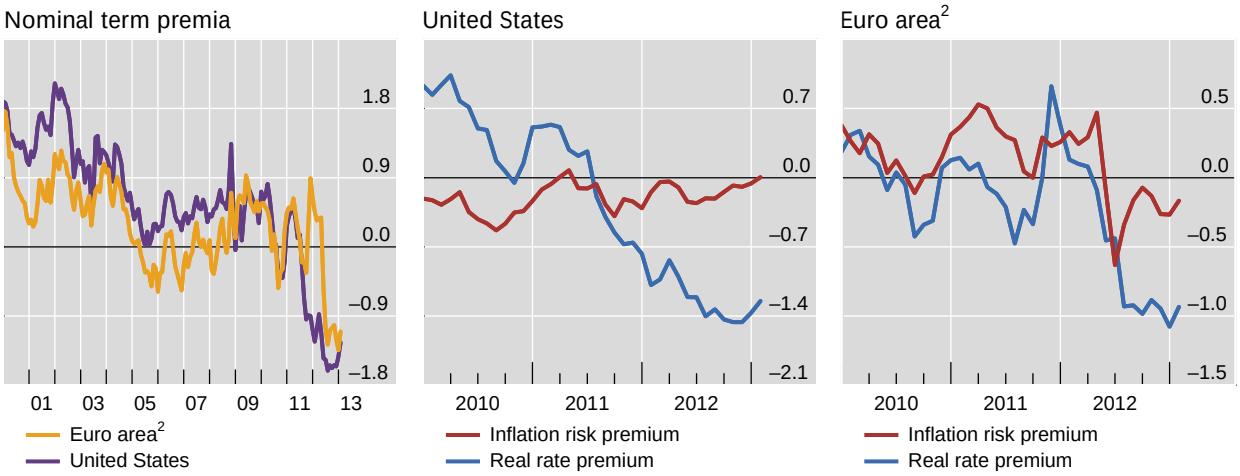
In Europe, the gradual relaxation in financial markets made fiscal consolidation less urgent. Assurances in July 2012 that "the ECB is ready to do whatever it takes to preserve the euro" had been followed by the announcement of a backstop (OMT) allowing for unlimited sovereign bond purchases when a member country submits to a macroeconomic adjustment programme. As investors moved back into euro area assets and unwound short positions, asset prices increasingly reflected the view that the ECB's commitment had removed the risk of a possible member country exit and currency redenomination. In addition, the poor euro area growth outlook led the authorities to allow several countries additional time to meet deficit targets. The pacing of fiscal tightening, both in the euro area and in the United States and Japan, helped lift equity markets. Other important parts of the global economy also saw policy support growth; to avert the risk of a hard landing in China, the authorities expanded infrastructure investment while promoting bank lending and non-bank financing.

Market participants also reacted positively to recent regulatory developments. On 7 January, the Basel Committee on Banking Supervision issued the revised liquidity coverage ratio (LCR) to be phased in more slowly with more lenient run-off assumptions and a broader definition of liquid assets (now including qualified mortgage-backed securities (MBS), corporate bonds and equity).[3] The market reaction included equity gains and credit default swap (CDS) spread compression, particularly among banks with lower liquidity ratios. In the United Kingdom, the Financial Services Authority provided assurances of regulatory flexibility to help support bank lending. Meanwhile, the UK government proceeded with plans to ring-fence UK banking groups, while turning down some of the stricter recommendations of the Vickers Report. Similarly, a European Commissioner stated that any implementation of the Liikanen proposal to separate trading activities from deposit-taking would have to avoid penalising lenders that were supporting the economy, while two alternative proposals emerged from France and Germany. Market analysts regarded these regulatory changes as helpful in relaxing some of the near-term challenges weighing on banks' earnings prospects.

On the monetary side, central banks maintained expansionary policies across the five major reserve currencies, including by holding nominal policy rates at or near zero. The Bank of England chose to allow inflation to remain above target over the near term. The Federal Reserve in December decided to keep the federal funds rate below 0.25% at least as long as unemployment remains above 6.5%, provided inflation expectations stay well anchored. Japan's resolve to lift growth and end deflation has created expectations that the Bank of Japan will further expand quantitative easing on the way to a higher inflation target of 2%.

Government bond risk premia[1]

In per cent — Graph 4



[1] Decomposition based on a joint macroeconomic and term structure model. See P Hördahl, O Tristani and D Vestin, "A joint econometric model of macroeconomic and term structure dynamics", *Journal of Econometrics*, vol 1.31, 2006, pp 405–44; and P Hördahl and O Tristani, "Inflation risk premia in the term structure of interest rates", *BIS Working Papers*, no 228, May 2007. [2] For the euro area, zero coupon yields on nominal and euro area HICP-linked bonds issued by the French Treasury have been used.

Sources: Bloomberg; © Consensus Economics; national data; BIS calculations.

[3] Separately, planned margin requirements for non-centrally cleared derivatives were eased to reduce the liquidity impact on market participants.

In this subdued macroeconomic environment, core government bond markets still benefited from sustained demand for high-quality paper. Continued monetary easing led the market to perceive that monetary tightening remained a remote prospect. An analysis of nominal yields on US Treasuries shows that the term premium, which compensates investors for the risks of inflation and movements in real rates, turned negative in 2011 and continued to decrease through 2012; in the euro area, the premium turned negative in mid-2012. In both markets, the premium decreased to levels representing record lows since at least 2000 (Graph 4, left-hand panel). A further decomposition of the term premium itself identifies the decline of the real (as opposed to inflation) part as the main driver behind the falling term premium (Graph 4, centre and right-hand panels). While monetary policy easing compressed the real rate premium, the flight to quality pushed the overall term premium into negative territory.

The major central banks continued to follow quantitative easing policies. The Federal Reserve continued its purchases of agency MBS and long-term Treasury securities at the rate of $85 billion per month, while the Bank of England complemented its asset purchases with a scheme to encourage bank lending to households and companies.[4] Between July 2007 and February 2013, the Federal Reserve's and the Bank of England's balance sheets grew by 254% and 394%, respectively, compared with 130% for the Eurosystem. Having extended more than €1 trillion in direct funding to euro area banks a year ago, the ECB has overseen the early repayment of €224 billion in LTROs so far. This makes the ECB the only major central bank whose balance sheet has been shrinking, as the OMT backstop has remained unused. The Swiss National Bank's balance sheet also stabilised, after its efforts to curb the Swiss franc's value vis-à-vis the euro had pushed its size above CHF 500 billion or 83% of GDP.

Concerns over the euro area recede

Tail risk concerns gave way to optimism as global financial markets took their cue from policy support. The reduction in downside risk in the euro area drove the euro sharply higher in January (Graph 5, left-hand panel). This appreciation went hand in hand with the unwinding of short positions in the euro (Graph 5, centre panel). Following these movements, investors regarded any further depreciation as less likely, in both the near and medium term. The one-month risk reversal, however, spiked up again following the recent Italian election results (Graph 5, right-hand panel).

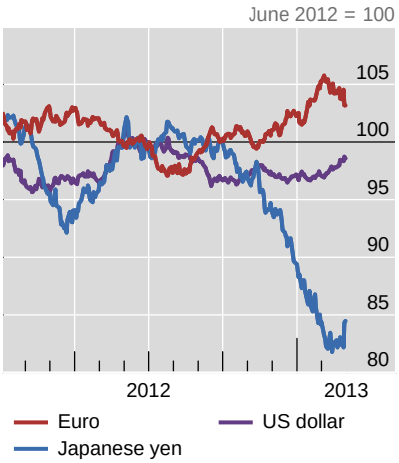
Market participants regarded the ECB's OMT facility as the single most important measure taken to mitigate downside risk. As market sentiment turned in September and improved further in early 2013, the euro area debt crisis weighed less on financial markets than at any time since 2010. During this time, the bond yields of stressed euro area sovereigns declined across maturities (Graph 6, left-hand panel). Spreads over German bunds fell by half from their June 2012 levels (and by nearly two thirds in Ireland and Portugal), settling in a range of 2.2 to 4.3%

[4] The special feature by Hofmann and Zhu in this issue examines the impact of US and UK asset purchase programmes on inflation expectations.

Euro

Graph 5

NEER advanced[1]



CFTC non-commercial net positions

Risk reversals[2] – dollar/euro

[1] Geometric weighted average of 60 bilateral nominal exchange rates, with weights based on trade in 2008–10. [2] Risk reversal is a measure of the skew in the demand for out-of-the-money options at high strikes compared with low strikes and can be interpreted as the market view of the most likely direction of the spot movement over the next maturity date. It is defined as the implied volatility for call options minus the implied volatility for put options on the base currency with the same delta. An increase indicates that market participants are willing to pay more to hedge against an appreciation of the US dollar.

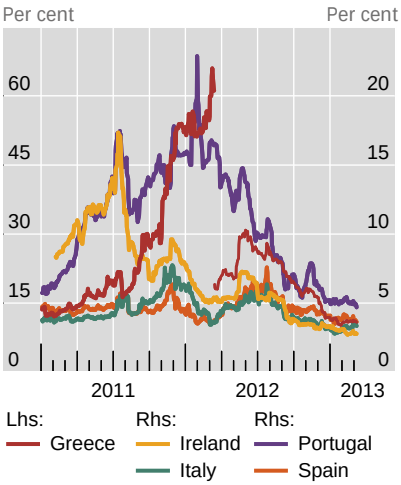
Sources: Bloomberg; US Commodity Futures Trading Commission (CFTC); BIS calculations.

for the five-year maturity. As risk premia declined, the credit curve became upward-sloping once again (Graph 6, centre panel). During much of 2011–12, CDS spreads had been abnormally high at the short end of the maturity spectrum, indicating that market participants had viewed a credit event as imminent.

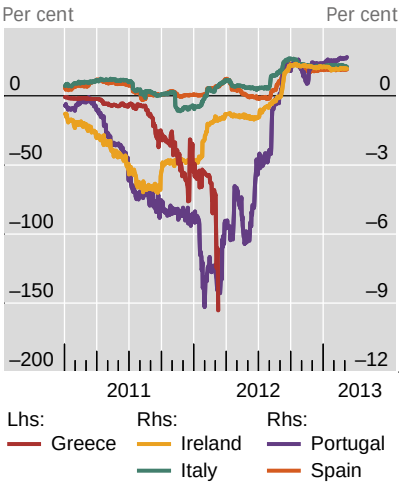
Euro area sovereigns

Graph 6

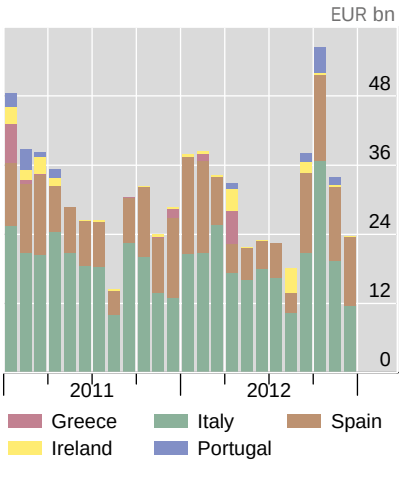
Five-year government bond yields[1]



Credit curve steepness[2]



Debt issuance[3]



[1] For Greece, the panel switches to the 10-year bond from 13 March 2012. [2] Difference between 10-year and two-year CDS spreads. Credit events specified by CDS contract clauses include default on scheduled payments and involuntary debt restructurings. Quotes on CDS referencing Greek debt ceased with the debt restructuring in March 2012. [3] Gross debt issuance of euro-denominated securities with original maturity of one year or more by central government.

Sources: ECB; Bloomberg; Markit.

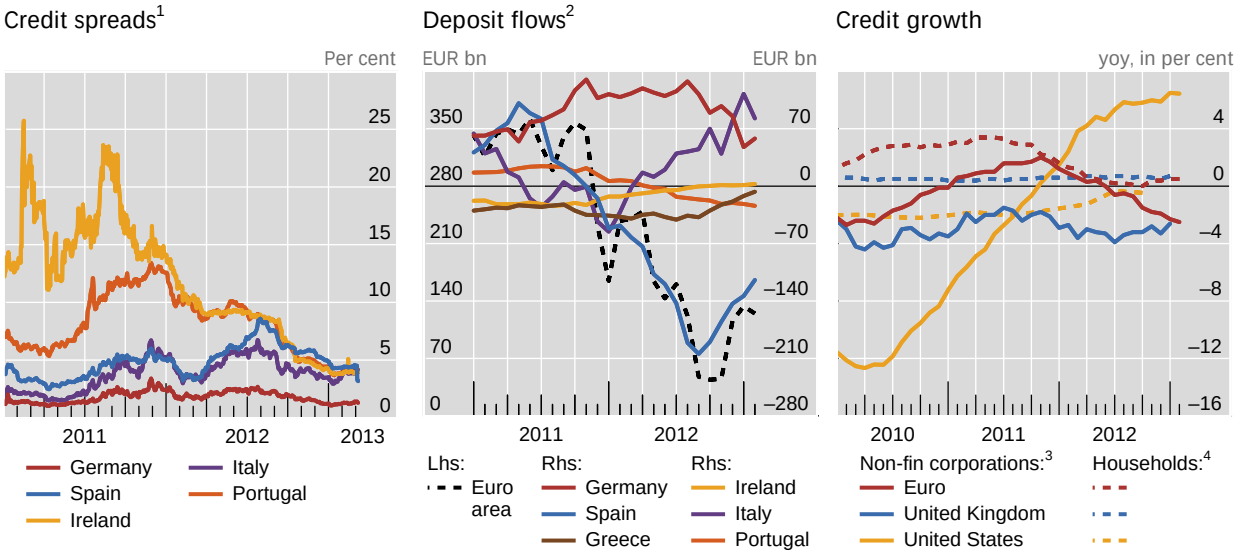
As market participants gradually moved back into euro area assets, sovereigns in the periphery were able to issue debt on better terms. Italian and Spanish bond auctions elicited robust demand in spite of deepening recessions and political uncertainty. In a sign that fiscal consolidation ultimately improved bond market access, Ireland and Portugal returned to the international debt market with major bond issues (Graph 6, right-hand panel). This was seen as an important step towards securing financing outside their official programmes. Likewise, some of the largest financial institutions headquartered in the euro area periphery regained access to wholesale funding markets.

These market dynamics briefly came to a halt in late February on concerns that the Italian election results might derail the reform agenda. On 26 February, euro area equities fell by 3%, led by the Milan index losing 5%. Italian government bond yields increased by more than 40 basis points, and CDS spreads jumped by 50 basis points. By 6 March, only half of the widening in spreads remained in place after markets had calmed down on reassurances from ECB and Federal Reserve officials that the central banks remained committed to accommodative policy.[5] The rebound was also helped by the Dow Jones reaching an all-time high on 5 March as US markets shrugged off fiscal concerns to focus on new signs of a US recovery.

The developments since last July boosted financial markets more broadly and also improved the condition of euro area banks. The interplay between the

Indicators of bank funding and credit growth

Graph 7



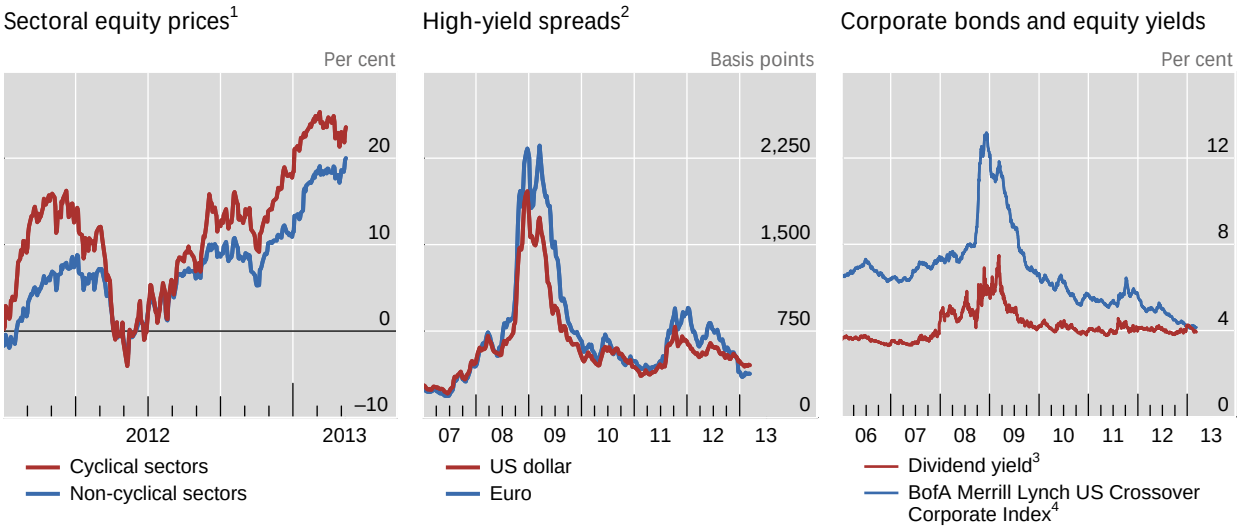
[1] Five-year on-the-run CDS spreads; simple average over a sample of domestic financial institutions. [2] Cumulated inflows of deposits from households and private non-financial companies over the preceding 12 months. [3] For the euro area, monetary financial institution (MFI) loans to non-financial corporations. For the United Kingdom, sterling loans to private non-financial corporations by UK-resident MFIs and related specialist mortgage lenders excluding the effects of securitisations and loans transfers. For the United States, commercial and industrial loans and commercial real estate loans by commercial banks in the United States. [4] For the euro area, MFI loans to households. For the United Kingdom, sterling loans to individuals by UK-resident MFIs and related specialist mortgage lenders excluding the effects of securitisations and loans transfers. For the United States, loans and debt securities excluding trade credit by all creditors.

Sources: ECB; Bank of England; Federal Reserve; national data.

[5] Markets showed the opposite reaction, with the S&P 500 losing nearly 1.5%, when Federal Open Market Committee minutes released on 20 February hinted at a possible rethinking of the pace of asset purchases.

Asset prices

Graph 8



[1] Cumulative changes in market capitalisation relative to the average of June 2012. Cyclical sectors are oil and gas, basic materials, industrials and finance. Non-cyclical sectors are consumer goods, consumer services, telecoms and utilities. [2] Bank of America Merrill Lynch index yields for a basket of non-investment grade corporate bonds. [3] Dow Jones US selected equity dividend index, 12-month dividend yield. [4] Yield to maturity.

Sources: Bank of America Merrill Lynch; Bloomberg; Datastream.

sovereign debt crisis and banking distress began to run in reverse, with stronger sovereigns leading to stronger banks. In addition, important measures were taken to strengthen banks, notably the €40 billion recapitalisation of Spanish banks financed out of the European Stability Mechanism. As a result, CDS spreads referencing euro area banks have declined substantially over the past six months in parallel to falling sovereign spreads (Graph 7, left-hand panel). Bank equity has consistently outperformed the general index in the past several months: since June 2012, the European bank sub-index has gained 46%, twice the percentage increase of the European index. During this period, deposit funding has also improved and earlier outflows from banks in Greece and Spain began to reverse (Graph 7, centre panel). These developments were mirrored in falling spreads on euro/dollar swaps and Libor-OIS in the main currencies. The improvement in bank funding conditions allowed hundreds of euro area banks to repay a higher than expected €137 billion in LTRO funding to the ECB in January. The €61 billion repayment in February, while this time only half of the market's median forecast, elicited no significant market reaction. The cumulative repayments reduced the ECB's net lending to banks to €596 billion.

It remains to be seen whether banks' improved condition translates into greater credit supply supporting an eventual economic recovery. Even as funding conditions eased, banks reported net tightening in their lending standards. Earnings prospects remain limited by various factors ranging from a weak economy to restructuring and litigation challenges. Moreover, on the demand side, many households still sought to repay debt and firms increasingly tapped the market to reduce their

reliance on banks. These developments accounted for relatively subdued credit growth (Graph 7, right-hand panel).[6]

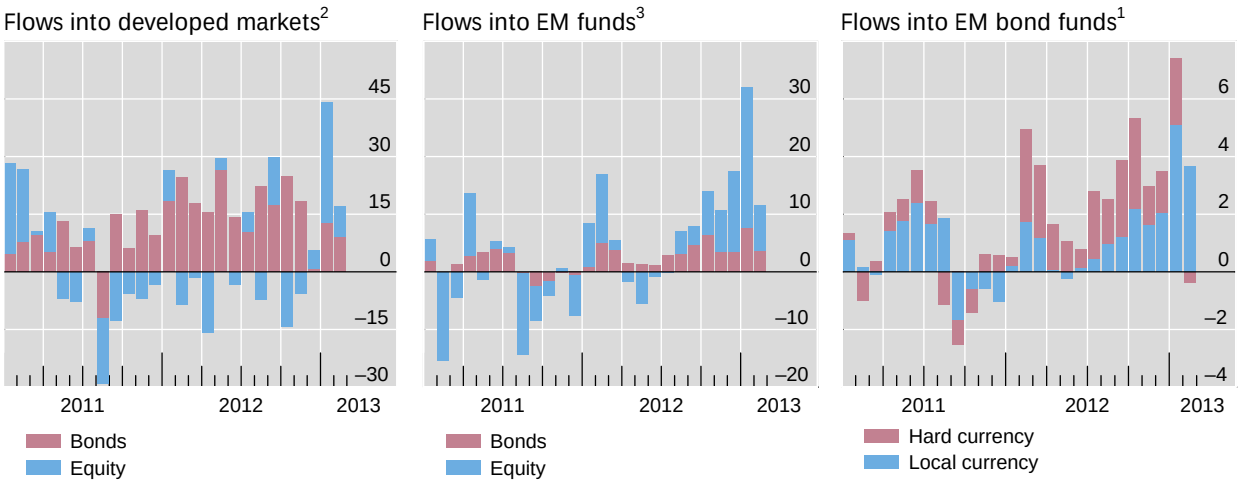
Elevated risk appetite and capital flows across asset classes

As tail risks receded, market participants became more willing to take on risk. This lifted equity prices generally, and the more risk-sensitive cyclical sectors in particular, extending a trend that had started in November 2012 (Graph 8, left-hand panel). In bond markets, high-yield corporate bond spreads narrowed to levels last seen prior to the euro area debt crisis (Graph 8, centre panel). Corporate bond yields declined more broadly, raising the relative attractiveness of investing in equity markets. Yields of lower-rated investment grade bonds (BBB–BB), for instance, became almost comparable to the dividend yield of high-dividend paying shares (Graph 8, right-hand panel).

Against this backdrop, capital flows moved into riskier asset classes. In 2012, funds investing in corporate bonds in the developed markets saw the largest inflows, but investors progressively moved into more risky asset categories. Inflows into equity funds soared in early 2013 (Graph 9, left-hand panel). Capital inflows to emerging market (EM) funds also surged, the largest part going to dedicated equity funds (Graph 9, centre panel). And within the emerging market bond fund category,

Portfolio flows[1]

In billions of US dollars — Graph 9



[1] Net portfolio flows (adjusted for exchange rate changes) to dedicated funds for individual countries and to funds for which country or at least regional decomposition is available. [2] Sum across Australia, Canada, the euro area, Japan, New Zealand, Switzerland, the United Kingdom and the United States. [3] Sum across China, Chinese Taipei, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand; Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela; and the Czech Republic, Hungary, Poland, Russia, South Africa and Turkey.

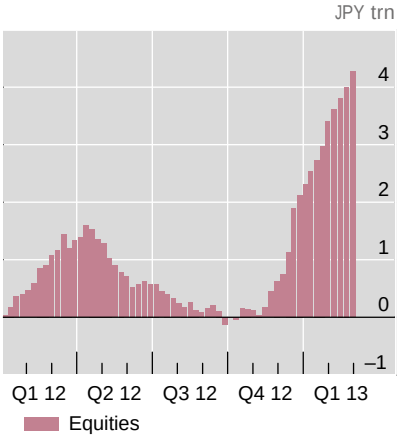
Sources: EPFR; BIS calculations.

[6] For the same reasons, measures designed to encourage bank lending, such as the Bank of England's Funding for Lending Scheme, experienced a slow take-up with mixed results.

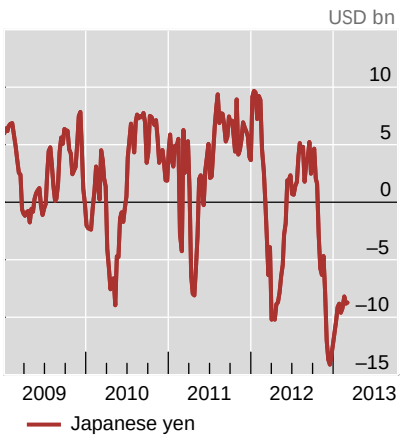
Portfolio inflows to the Japanese equity market and the yen

Graph 10

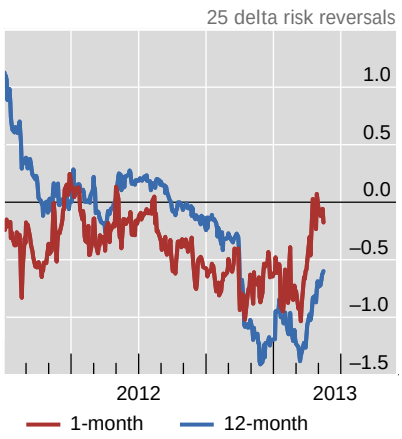
Cumulative inward portfolio investment to equity market



CFTC non-commercial net positions



Risk reversals[1] – yen/dollar



[1] Risk reversal is a measure of the skew in the demand for out-of-the-money options at high strikes compared with low strikes and can be interpreted as the market view of the most likely direction of the spot movement over the next maturity date. It is defined as the implied volatility for call options minus the implied volatility for put options on the base currency with the same delta. An increase indicates that market participants are willing to pay more to hedge against an appreciation of the yen.

Sources: Bloomberg; BIS calculations.

investors increasingly sought funds investing in local currency-denominated bonds, exposing themselves to emerging market currency risk (Graph 9, right-hand panel).

Global capital flows were also associated with a substantial depreciation of the yen (Graph 5, left-hand panel). During this period, foreign investors were channelling portfolio flows into the Japanese equity market, expecting higher profits at Japanese firms, especially in the export sector, following the currency's substantial depreciation (Graph 10, left-hand panel). Similar capital inflows into Japanese equity had occurred in past episodes of yen depreciation, as in the first quarter of 2012. This time, the policy shift in Japan coincided with an increase in global risk appetite. Meanwhile, speculative derivatives transactions shorting the yen played a role in its depreciation (Graph 10, centre panel). Judging by option-based indicators, market participants continued to expect a depreciation of the yen in the future (Graph 10, right-hand panel).

Highlights of the BIS international statistics[1]

The BIS, in cooperation with central banks and monetary authorities worldwide, compiles and disseminates several data sets on activity in international financial markets. This chapter summarises the latest data for the international banking markets, available up to the third quarter of 2012. The box analyses the structure of the market for bonds issued by corporates from emerging market economies.

During the third quarter of 2012, the cross-border claims of BIS reporting banks registered the smallest quarterly increase in 13 years. An expansion of cross-border credit to non-banks, especially those located in the United States, was largely offset by a decline in claims on banks in the euro area. Across reporting areas, cross-border claims on mature economies increased, while those on emerging market economies and offshore financial centres fell. For the first time, Korean banks reported consolidated banking statistics on an immediate borrower basis.

New reporting country in the consolidated statistics: Korea

The BIS is for the first time releasing consolidated banking statistics for Korean banks.[2] Korean data starting from the fourth quarter of 2011 are now available on an immediate borrower basis. The addition of Korea brings to 31 the number of countries contributing to the consolidated banking statistics on an immediate borrower basis. Korean banks have been providing locational banking statistics since 2005.

[1] This article was prepared by Adrian van Rixtel (adrian.vanrixtel@bis.org) for banking statistics. Statistical support was provided by Pablo García-Luna, Koon Goh and Serguei Grouchko.

[2] The consolidated banking statistics are structured according to the nationality of reporting banks and are reported on a worldwide consolidated basis, ie excluding inter-office positions. In the consolidated banking statistics on an immediate borrower basis, claims are allocated to the country of the immediate counterparty. In the consolidated statistics on an ultimate risk basis, claims are allocated to the country of the ultimate obligor, after taking into account risk transfers, such as credit default swap protection bought and parent or third-party guarantees.

The foreign claims[3] of banks headquartered in Korea stood at $121 billion at end-September 2012, comparable in size to the foreign claims of Brazilian banks ($98 billion) and Portuguese banks ($123 billion). Roughly half of Korean banks' foreign claims were on counterparties in the Asia-Pacific region, led by borrowers in China, Hong Kong SAR and Japan. Among BIS reporting banks at end-September 2012, Korean banks were the largest creditors to Cambodia and Uzbekistan, and the second largest to Vietnam.

The bulk of Korean banks' foreign claims are cross-border claims booked from their headquarters or major financial centres rather than as local claims extended in local currencies by their foreign affiliates. Local claims in local currencies accounted for only 8% of Korean banks' total foreign claims at end-September 2012. By contrast, across all BIS reporting banks, local claims in local currencies accounted for 37% of total foreign claims.

The international banking market in the third quarter of 2012

The cross-border claims of BIS reporting banks rose by only $33 billion (0.1%) between end-June 2012 and end-September 2012 (Graph 1, top left-hand panel).[4] The increase was driven by a $153 billion (1.4%) expansion in cross-border claims on non-banks. In contrast, lending to banks fell by $120 billion (0.7%).

The modest increase in cross-border claims was concentrated in those denominated in US dollars, sterling and non-major currencies, which increased by $47 billion (0.5%), $34 billion (4.5%) and $70 billion (3.8%), respectively (Graph 1, top right-hand panel). Claims denominated in euros fell the most, by $127 billion (3.6%).

Credit to advanced economies

The BIS locational banking statistics indicate that cross-border claims on advanced economies expanded slightly in the third quarter of 2012, by $106 billion (0.5%). It was the first expansion after three consecutive declines and compared with a decrease of $321 billion in the previous quarter. Claims on non-bank borrowers increased for the third consecutive quarter, by $101 billion (1.3%). In contrast, interbank claims remained largely unchanged, registering a minor increase of $5.5 billion (0.04%).

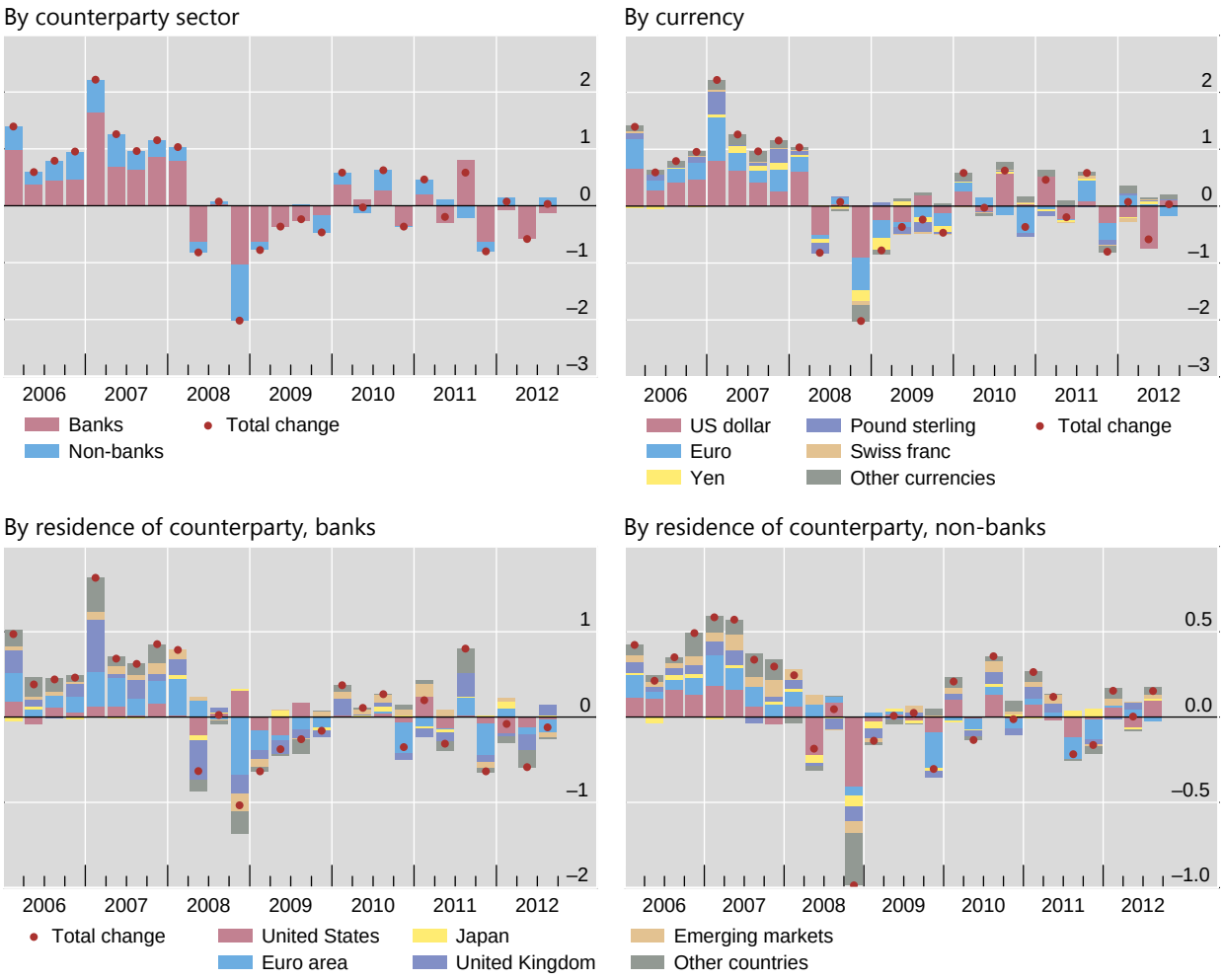
The relative stability of aggregate claims on banks in mature economies hides significant shifts out of the euro area to other jurisdictions, particularly the United Kingdom. Cross-border claims on banks in the United Kingdom increased by

[3] Foreign claims comprise cross-border claims and local claims in both local and foreign currencies. Local claims refer to credit extended by banks' foreign offices to residents of the host country.

[4] The analysis in this section is based on the BIS locational banking statistics by residence, in which creditors and debtors are classified according to their residence (as in the balance of payments statistics), not according to their nationality. All reported flows in cross-border claims have been adjusted for exchange rate fluctuations and breaks in series.

Changes in gross cross-border claims[1]

In trillions of US dollars — Graph 1



[1] BIS reporting banks' cross-border claims include inter-office claims.

Source: BIS locational banking statistics by residence.

$122 billion (3.4%), while those on banks in the euro area contracted by $155 billion (2.8%) (Graph 1, bottom left-hand panel). Within the euro area, claims on banks in almost every country fell. The locational statistics by nationality, which have a more refined counterparty sector breakdown, show that reduced cross-border inter-office activity accounted for much of the contraction.

The increase in cross-border claims on non-bank borrowers was driven by those on the United States. The locational banking statistics show a $95 billion (3.8%) rise in these positions in Q3 2012 (Graph 1, bottom right-hand panel). This was the second largest increase in two years. The expansion of credit to the non-bank sector in the US was provided mostly through loans and debt securities. The consolidated banking statistics, which contain a more refined breakdown of non-bank borrowers, indicate that this additional credit was mainly granted to the non-bank private sector as opposed to the public sector.

International debt securities of the corporate sector in emerging market economies

Agustín Villar

Private portfolio capital inflows to emerging markets are rising rapidly. According to the Institute of International Finance, private non-bank inflows into emerging market economies (EMEs) increased from $155 billion to $365 billion between 2009 and 2012 and have since remained close to the historical peak they reached in 2011. While private inflows intermediated through debt capital markets jumped, bank inflows fell slightly from $154 billion to $147 billion in the same period.① In particular, strong demand from foreign investors led to a surge of activity in EME corporate bond markets during 2012 and early 2013. This box discusses some changes observed in the light of heightened activity in markets for international debt securities issued by financial and non-financial corporates of EMEs and reviews some structural aspects.

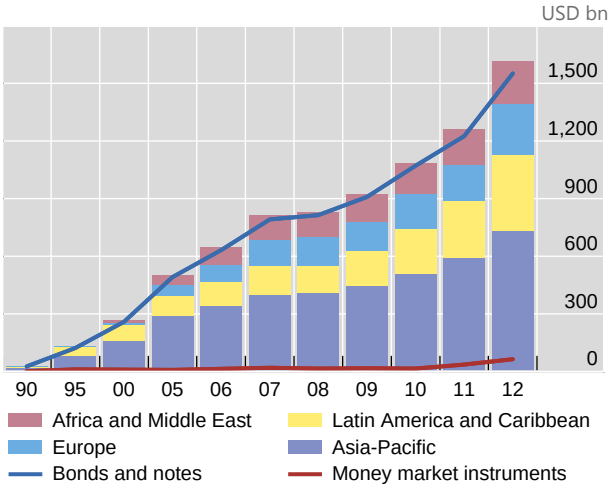
Investor surveys revealed that assets under management benchmarked to the emerging corporate bond index rose by 60.5% in 2012, posting a greater increase than any other asset class followed by these surveys. By comparison, assets managed against the emerging market broad index benchmarks – comprising sovereign and corporate international bonds and sovereign local-currency bonds – grew by just under 30% to $560 billion in 2012.② The demand for emerging market corporate bonds has been dominated by high net worth retail investors. Although institutional demand for EME international corporate bonds has remained comparatively small – less than 10% of the market compared to about 50% of the international sovereign bond market – this share may well continue to increase. Greater activity by global money managers is likely to help the deepening of this market.

International debt securities statistics③ compiled by the BIS show that the stock of corporate debt securities issued by financial and non-financial corporations headquartered in EMEs totalled more than $1.6 trillion at end-2012 (Graph A, left-hand panel). Foreign and international bonds and notes account for some 95% of the total stock. Money market instruments make up the difference.

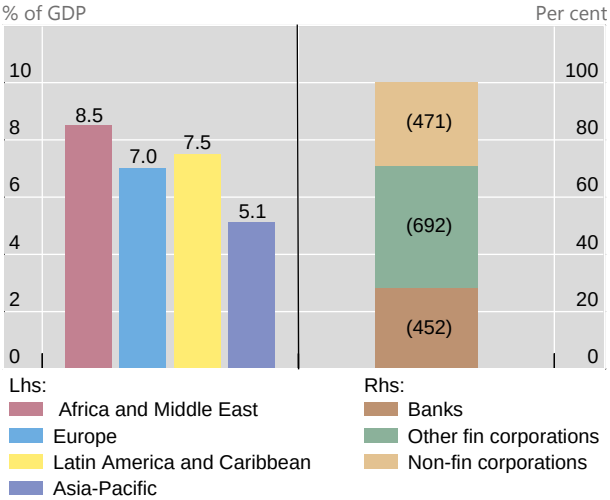
Corporate debt securities in EMEs[1]

Amounts outstanding — Graph A

By region and type of instrument



By region and sector of issuer, end-2012



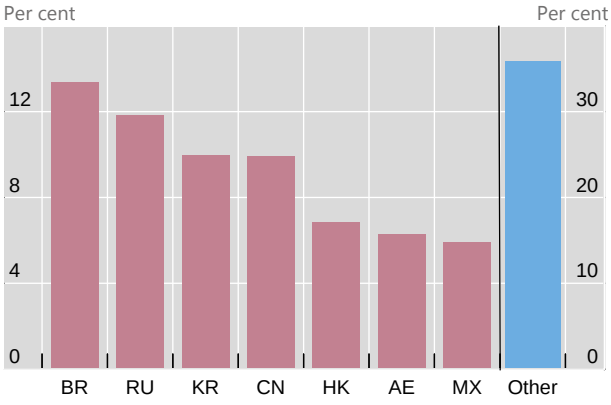
[1] Issuers are financial or non-financial corporations whose owners are resident in selected EMEs. The selected EMEs are grouped by region: Africa and the Middle East (Bahrain, Egypt, Israel, Kuwait, Nigeria, Oman, Qatar, Saudi Arabia, South Africa and the United Arab Emirates); Europe (Croatia, the Czech Republic, Hungary, Poland, Russia, Turkey and Ukraine); Latin America and the Caribbean (Argentina, Barbados, Brazil, Chile, Colombia, the Dominican Republic, El Salvador, Jamaica, Mexico, Peru and Venezuela); and Asia-Pacific (China, Chinese Taipei, Hong Kong SAR, India, Indonesia, Kazakhstan, Korea, Macao SAR; Malaysia, Mongolia, the Philippines, Singapore and Thailand).

Sources: Dealogic; Euroclear; Thomson Reuters; Xtrakter Ltd; BIS calculations.

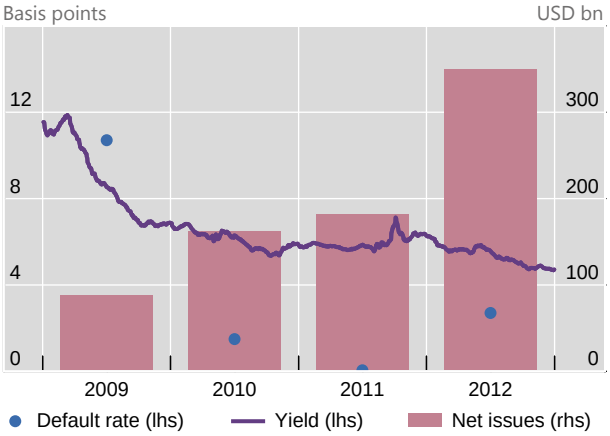
Corporate debt securities in EMEs

Graph B

Distribution by country, end-2012[1]



Default rates, yields and net issues[2]



AE = United Arab Emirates; BR = Brazil; CN = China; HK = Hong Kong SAR; KR = Korea; MX = Mexico; RU = Russia; Other = other EMEs.

[1] Amounts outstanding. [2] Default rates from JPMorgan, *Emerging Markets Corporate Outlook & Strategy*, December 2012. Yield to maturity based on the CEMBI BROAD Yield to Maturity.

Sources: Dealogic; Euroclear; JPMorgan Chase; Thomson Reuters; Xtrakter Ltd; BIS calculations.

Debt securities issued by banks and other financial institutions make up the bulk of the stock of international corporate debt securities (Graph A, right-hand panel). As of end-2012, financial institutions had more than $1.1 trillion worth of debt securities outstanding, about two thirds of the total. This is smaller than the sector's share in developed economies (84%), where the universe of securities is 10 times larger.

Asian entities are the largest issuers in the international market for EME corporate debt securities, followed by Latin American firms. The stock of debt securities issued by emerging European and Middle East and African entities is smaller, but has grown rapidly in recent years. However, the relative sizes change considerably if debt issuance is viewed in relation to regional output. From this perspective, Middle East and Africa has the largest share, and Asia the smallest one (Graph A, right-hand panel).

The regional pattern shows that this market is concentrated within a handful of economies. At a country level, national entities from Brazil, China, Hong Kong SAR, Korea, Mexico, Russia and the United Arab Emirates hold the largest market shares in the outstanding stock. A group of about 30 other EMEs account for the remaining debt securities (Graph B, left-hand panel).

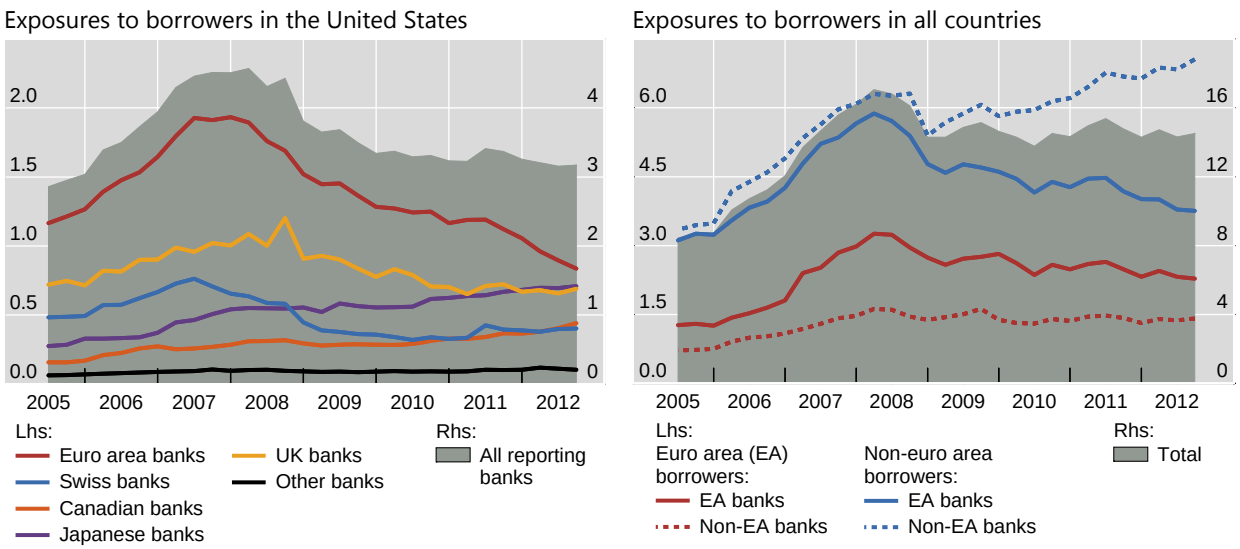
The investable share of the stock of international corporate debt securities available to international investors is rather smaller due to size, liquidity and risk characteristics. The broadest benchmark index for emerging corporate bond markets (CEMBI) covers debt securities in the form of bonds that are worth about $620 billion. Financials account for 36% of this amount, much less than their share in the total stock. The investable index allows global investors to gain exposure to EME sectors such as oil and gas (13.5%); telephone, media and technology (11.1%); and commodities (10.5%). Fewer opportunities exist in real estate (5%) and consumer goods (6%), sectors that are usually linked to fast-growing domestic demand in EMEs.

The perceived credit quality of EME corporate bonds still depends heavily on that of the sovereign. Within the limits set by this sovereign credit "ceiling", higher macroeconomic volatility in EMEs is reflected in changes in perceived risk and volatility. An improvement in perceived credit risk has translated into the reduced yields and compressed spreads seen at present (Graph B, right-hand panel). Default rates have remained low (about 2.7% by one estimate) in the aftermath of the financial crisis. But the historical fluctuations in these rates have been considerable. At times of macroeconomic and financial stress, default rates have seen significant increases: in 2002, for example, they jumped to 15.4% and in 2009 they topped 10.7%. Under the less challenging macroeconomic conditions of recent years, they have fluctuated between 0 and 2.7%.

① "Capital flows to emerging market economies", *IIF Research Note*, 22 January 2013. ② G Kim, "2012 Index Review", *JPMorgan Fixed Index Product Guide*, January 2013. ③ For details about the universe of securities covered, see B Gruić and P Wooldridge, "Enhancements to the BIS debt securities statistics", *BIS Quarterly Review*, December 2012, pp 63–76.

BIS reporting banks' consolidated exposures to the non-bank private sector[1]

In trillions of US dollars — Graph 2



[1] Positions valued at contemporaneous exchange rates, and thus changes in stocks include exchange rate valuation effects.

Source: BIS consolidated banking statistics (ultimate risk basis).

Total foreign exposures to the US non-bank private sector, including local claims booked by foreign banks' offices in the United States, changed little on an ultimate risk basis, notwithstanding the increase in cross-border claims on US non-bank borrowers (Graph 2, left-hand panel, shaded area).[5]

The stability of overall foreign exposures to the United States masked a continued shift in the distribution of lending banks' nationality. Euro area banks' share of total foreign claims on the US non-bank private sector on an ultimate risk basis fell to 26% at end-September 2012, compared with a peak of 43% at end-June 2007. This primarily reflected the lower claims of Dutch and German banks. Over the same period, the share of Japanese banks increased to 22% and that of Canadian banks to 14%, up a respective 12 and 8 percentage points.

At the global level too, the consolidated statistics on an ultimate risk basis indicate a growing bifurcation between foreign claims on the non-bank private sector booked by euro area banks and those booked by other banks. Overall foreign claims on this sector have been relatively flat since 2008. However, differences between developments inside and outside the euro area are evident. As shown by the solid lines in the right-hand panel of Graph 2, the foreign claims of euro area banks on the non-bank private sector worldwide have trended downwards since 2008, particularly vis-à-vis borrowers outside the euro area (blue solid line). By contrast, the claims of non-euro area banks have continued to expand (dashed lines), particularly vis-à-vis borrowers outside the euro area (blue dashed line).

[5] The BIS consolidated international banking statistics on an ultimate risk basis break down exposures according to where the ultimate debtor is headquartered. These exposures are classified according to the nationality of banks (ie according to the location of banks' headquarters), not according to the location of the office in which they are booked. In addition, the classification of counterparties takes into account risk transfers between countries and sectors.

Credit to emerging market economies

Cross-border claims on borrowers in emerging economies contracted slightly, by $30 billion (0.9%), in the third quarter of 2012. Claims on banks fell by $55 billion (3.3%), especially in Asia-Pacific and Latin America. Cross-border claims on non-bank borrowers expanded modestly (by $26 billion or 1.7%).

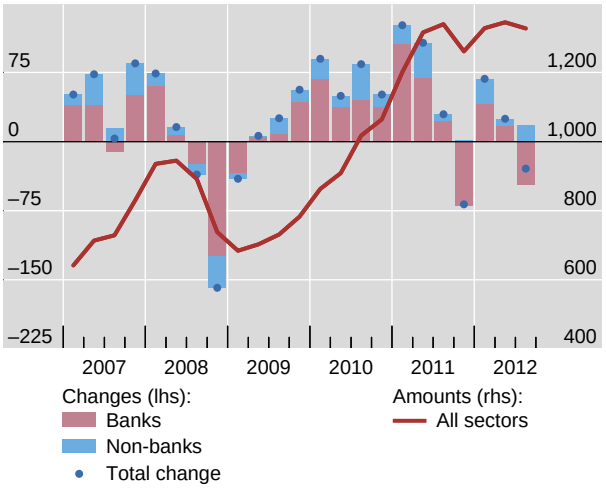
In Asia-Pacific, cross-border claims on banks fell by $47 billion (5.5%) in the third quarter of 2012, recording only the third quarterly decline since 2009 (Graph 3, left-hand panel). The decline was driven by claims on banks in China and Korea, which fell by $48 billion (13%) and $9 billion (6%), respectively. In the case of China, the contraction was the largest since the start of the BIS locational banking statistics. Foreign claims on Asia-Pacific banks, which include claims extended by local affiliates of BIS reporting banks, also fell on an ultimate risk basis, by $36 billion (unadjusted for exchange rate movements) to $466 billion (Graph 3, right-hand panel). This was the lowest amount outstanding of foreign credit to banks in the region since the fourth quarter of 2010. Banks from all major reporting countries, including those in the region, retreated from interbank lending to Asia-Pacific.

In Latin America, cross-border claims on banks, including inter-office positions, fell by $11 billion (4.3%) between end-June and end-September 2012 (Graph 4, left-hand panel). This was the largest quarterly contraction since 2009. Even so, the consolidated statistics on an ultimate risk basis indicate that BIS reporting banks' total exposures to banks in the region increased. Foreign claims on banks were up by $16 billion (unadjusted for exchange rate movements), to $156 billion at end-September 2012 (Graph 4, right-hand panel). This reflected an increase in interbank credit booked by BIS reporting banks' affiliates in Latin America. Interbank

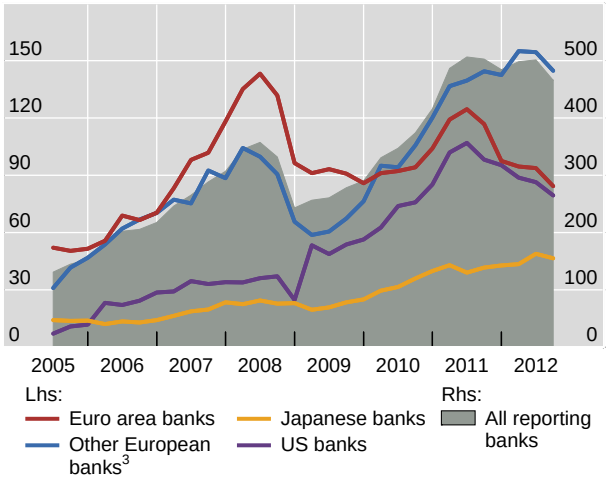
BIS reporting banks' positions on Asia-Pacific

In billions of US dollars — Graph 3

Cross-border positions, by counterparty sector[1]



Claims on banks, by bank nationality[2]



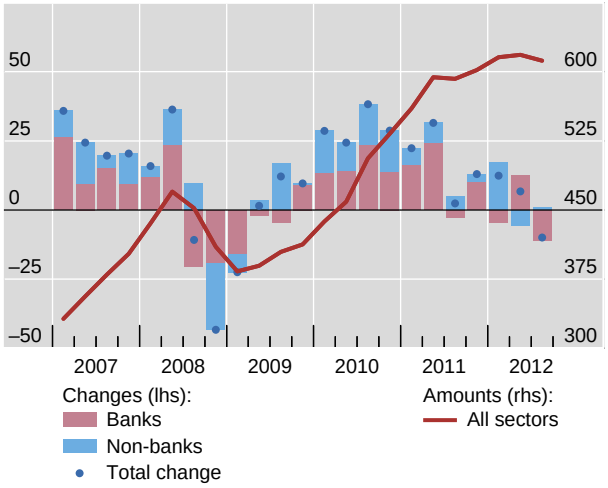
[1] BIS reporting banks' cross-border claims include inter-office claims. [2] Consolidated foreign claims comprise cross-border claims and claims extended by local affiliates in the borrowing country. [3] Norway, Sweden, Switzerland, Turkey and the United Kingdom.

Sources: BIS locational banking statistics by residence; BIS consolidated banking statistics (ultimate risk basis).

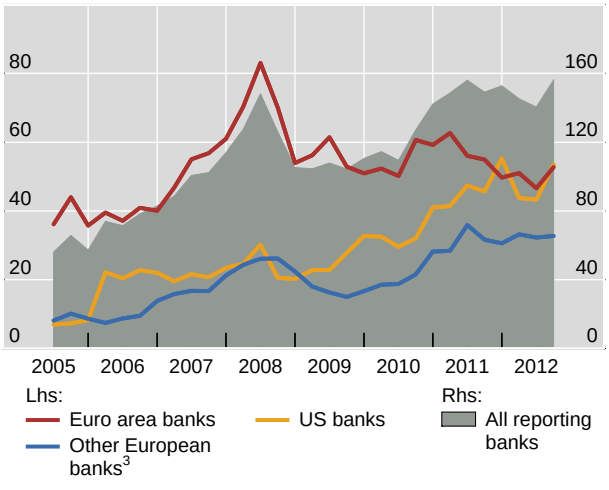
BIS reporting banks' positions on Latin America and the Caribbean

In billions of US dollars — Graph 4

Cross-border positions, by counterparty sector[1]



Claims on banks, by bank nationality[2]



[1] BIS reporting banks' cross-border claims include inter-office claims. [2] Consolidated foreign claims comprise cross-border claims and claims extended by local affiliates in the borrowing country. [3] Norway, Sweden, Switzerland, Turkey and the United Kingdom.

Sources: BIS locational banking statistics by residence; BIS consolidated banking statistics (ultimate risk basis).

exposures on the region increased particularly for euro area (mainly Spanish) banks and US banks.

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Central bank asset purchases and inflation expectations[1]

This article analyses the effect of the asset purchase programmes implemented by the Federal Reserve and the Bank of England in the wake of the global financial crisis on market- and survey-based measures of inflation expectations. The analysis suggests that central bank asset purchases did have significant effects, but that their quantitative importance is uncertain. While short- and longer-term inflation expectation measures displayed sizeable upward movements towards pre-crisis levels during the implementation of asset purchase programmes, the reaction of inflation swap rates on the days of programme announcements suggests that central bank asset purchases were probably not the main driver of these shifts.

JEL classification: E31, E52, E58.

The global financial crisis and the ensuing Great Recession have led to fundamental changes in the design and implementation of monetary policy. Many central banks had reduced policy rates to near zero levels by early 2009 and adopted less conventional policy tools in order to directly address financial sector strains or to provide additional monetary stimulus. In a number of major advanced economies, central bank purchases of longer-maturity assets, including both government bonds and private debt, have become the predominant unconventional monetary policy instrument.

The public debate and the research on the effects of central bank asset purchase programmes have focused on their impact on interest rate spreads and the level of longer-term interest rates and asset prices as well as their short-run effects on aggregate economic activity and inflation.[2] More recently, however, the potential implications of these programmes for long-run inflation and inflation expectations have received increasing attention. For instance, a number of

[1] The views expressed in this article are those of the authors alone and do not necessarily reflect those of the BIS. We are grateful to Claudio Borio, Stephen Cecchetti, Dietrich Domanski, Andreas Schrimpf and Christian Upper for useful comments on earlier drafts of the article, to Anamaria Illes and Bilyana Bogdanova for expert assistance with data and graphs, and to Matina Negka for data support.

[2] See eg Meaning and Zhu (2011, 2012) on the impact on Treasury yields and other financial prices of Federal Reserve and Bank of England asset purchase programmes, and Chen et al (2012) and Gambacorta et al (2012) for analyses of the macroeconomic impact of central bank balance sheet policies.

observers have argued that the programmes entail significant upside risks to price stability and hence of a major slippage of inflation expectations through their potential to trigger a massive increase in money supply (eg Thornton (2012), Reynard (2012)). On the other hand, it has been argued that large-scale asset purchases have been insufficiently effective in stimulating economies, as they did not lift inflation expectations and thereby failed to lower real interest rates enough to bring economies back to their pre-crisis trajectories (eg Woodford (2010)).

Yet few studies have analysed the impact on inflation expectations of large-scale asset purchases by central banks. Guidolin and Neely (2010) perform an event study of the effect of the Federal Reserve's first asset purchase programme on 10-year bond market break-even inflation rates and find a modest, albeit statistically significant positive effect. In contrast, Wright (2012), also covering the announcements of the asset purchases, does not find a significant effect of monetary policy shocks at the zero lower bound on US break-even rates over a period spanning three asset purchase programmes.

In this article, we extend this literature by analysing the impact on inflation expectations of US and UK asset purchase programmes, taking different analytical perspectives and allowing the effects to vary across programmes. Specifically, we analyse both the developments of inflation expectation measures in the course of the implementation of the programmes and the impact of the programme announcements based on an event study and regression analysis. The findings of our analysis suggest that the effects of asset purchase programmes on inflation expectations are surrounded by a high degree of uncertainty. The implementation of the various asset purchase programmes has been associated with sometimes sizeable upward movements in inflation expectation measures towards levels that are broadly consistent with central banks' inflation target levels. The announcements of the programmes led to economically and statistically significant daily increases in medium- and long-term inflation swap rates in the United States, while the effects on UK inflation swap rates have been negligible. This suggests that asset purchase programmes have probably not been the main driver of inflation expectations. A caveat to this conclusion is that announcement impacts may not capture the full effects of the programmes.

Central bank asset purchase programmes

Since late 2008, the Federal Reserve and the Bank of England have carried out a number of large-scale asset purchase programmes in order to improve financial conditions, revive credit flows and stimulate economic activity. The Federal Reserve launched the first Large-Scale Asset Purchase Programme (LSAP1) in November 2008 and March 2009, with announced purchases of $1.75 trillion ($1.45 trillion in agency mortgage-backed securities (MBS) and agency debt, $300 billion in long-term Treasury securities). The second round of the Federal Reserve's large-scale asset purchases (LSAP2) started in August 2010 with the reinvestment of the principal payments on agency security holdings into long-term Treasuries. In November 2010, purchases of a further $600 billion of long-term Treasuries were announced. Under the Maturity Extension Program (MEP) initiated in September 2011 and extended in June 2012, the Federal Reserve sold $667 billion of shorter-term Treasury securities and used the proceeds to buy

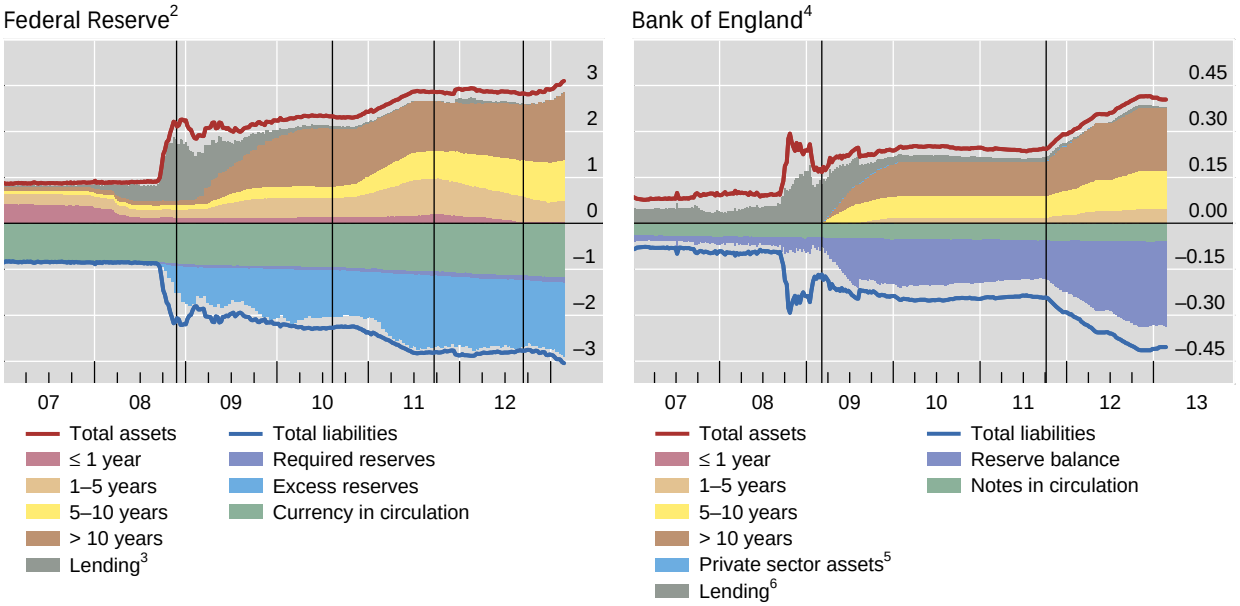
longer-term Treasury securities. In September 2012, the Federal Reserve announced LSAP3, which involves open-ended purchases of agency MBS at the pace of $40 billion per month. In December 2012, this programme was expanded by purchases of $45 billion in Treasury bonds per month after the completion of the MEP.

The Bank of England established its Asset Purchase Facility (APF) Fund in January 2009, initiating a first round of large-scale asset purchases (APF1). On 5 March 2009, the Bank of England's Monetary Policy Committee announced that it would buy £75 billion in high-quality assets, focusing on government bonds. The total amount of asset purchases under APF1 was successively raised to £200 billion by November 2009. On 6 October 2011, the Bank of England decided to resume gilt purchases, expanding the APF to £275 billion (APF2). The APF was subsequently further expanded, to £325 billion in February 2012 and to £375 billion in July 2012.

Reflecting these asset purchase programmes, the Federal Reserve and Bank of England balance sheets have expanded considerably since the third quarter of 2008, more than tripling and quadrupling in size, respectively, by January 2013 (Graph 1). The programmes have also had a significant effect on the composition of the balance sheets. This has tilted increasingly towards longer-dated assets, with debt instruments of maturity beyond five years dominating the two institutions'

Central bank balance sheets[1]

In trillions of national currency units — Graph 1



[1] Breakdown of securities held outright refers to remaining maturity. The vertical lines represent the launch date of each asset purchase programme. For the United States: 25 November 2008 (LSAP 1), 10 August 2010 (LSAP 2), 21 September 2011 (MEP) and 13 September 2012 (LSAP 3). For the United Kingdom: 5 March 2009 (APF 1) and 6 October 2011 (APF 2). [2] The breakdown of securities held outright by the Federal Reserve includes agency debt and MBS and US Treasuries; face value. [3] Includes repurchase agreements, term auction credit, other loans, Commercial Paper Funding Facility and central bank liquidity swaps. [4] The breakdown of the Bank of England assets includes gilt holdings of the Asset Purchase Facility (APF). APF transactions are undertaken by the Bank of England Asset Purchase Facility Fund Limited. The accounts of the Fund are not consolidated with those of the Bank. The Fund is financed by loans from the Bank which appear on the Bank's balance sheet as an asset. [5] Includes holdings of sterling commercial paper, secured commercial paper and corporate bonds financed by the issue of Treasury bills and the Debt Management Office's cash management operations and by the creation of central bank reserves. [6] Includes sterling reverse repo operations and currency swaps.

Sources: Bank of England; Federal Reserve; Datastream.

asset holdings. The liabilities side of the balance sheets grew through the expansion of bank reserves.

Asset purchase programmes and inflation expectation dynamics

How have large-scale asset purchase programmes influenced inflation expectations? As a first step to addressing this question, we explore in this section the fluctuations of US and UK market- and survey-based inflation expectation measures in the course of the different programmes. To that end, we consider one-, five- and 10-year inflation swap rates as well as implied five-year, five-year forward inflation swap rates, computed based on the five- and 10-year rates, as market-based measures of inflation expectations (Graph 2, left-hand panels). An inflation swap is a derivative instrument that exchanges a fixed payment for a variable payment linked to a measure of inflation, typically the accrued CPI inflation over the life of the swap. The fixed leg of the inflation swap, the inflation swap rate, therefore provides a daily measure of investors' inflation expectations. Bond market break-even rates display dynamics similar to those of inflation swap rates, but may have been significantly distorted by changes in differential liquidity premia in nominal and inflation-linked bond markets over parts of the sample period.[3] That said, inflation swap rates are also an imperfect measure of inflation expectations, as, like bond market break-even rates, they contain an inflation risk premium compensating for the uncertainty of inflation outcomes and other market-specific risk premia.[4]

We further consider survey-based short- and long-term CPI inflation forecasts from Consensus Economics (Graph 2, right-hand panels).[5] Forecasts of inflation for the current and the next year are available on a monthly basis and can be used to construct a monthly measure of one-year-ahead inflation expectations as a weighted average (Gerlach et al (2011)). Long-horizon consensus forecasts of CPI inflation, referring to the average rate of CPI inflation expected to prevail six to 10 years in the future, are available only twice a year.

The graph panels suggest that the massive expansion of central bank asset holdings was not associated with major concerns over rising inflation, but may have helped to dispel imminent deflation fears after the collapse of Lehman Brothers in September 2008. Three main observations stand out. First, the initial announcement of large-scale asset purchase programmes was followed by a rapid rebound of

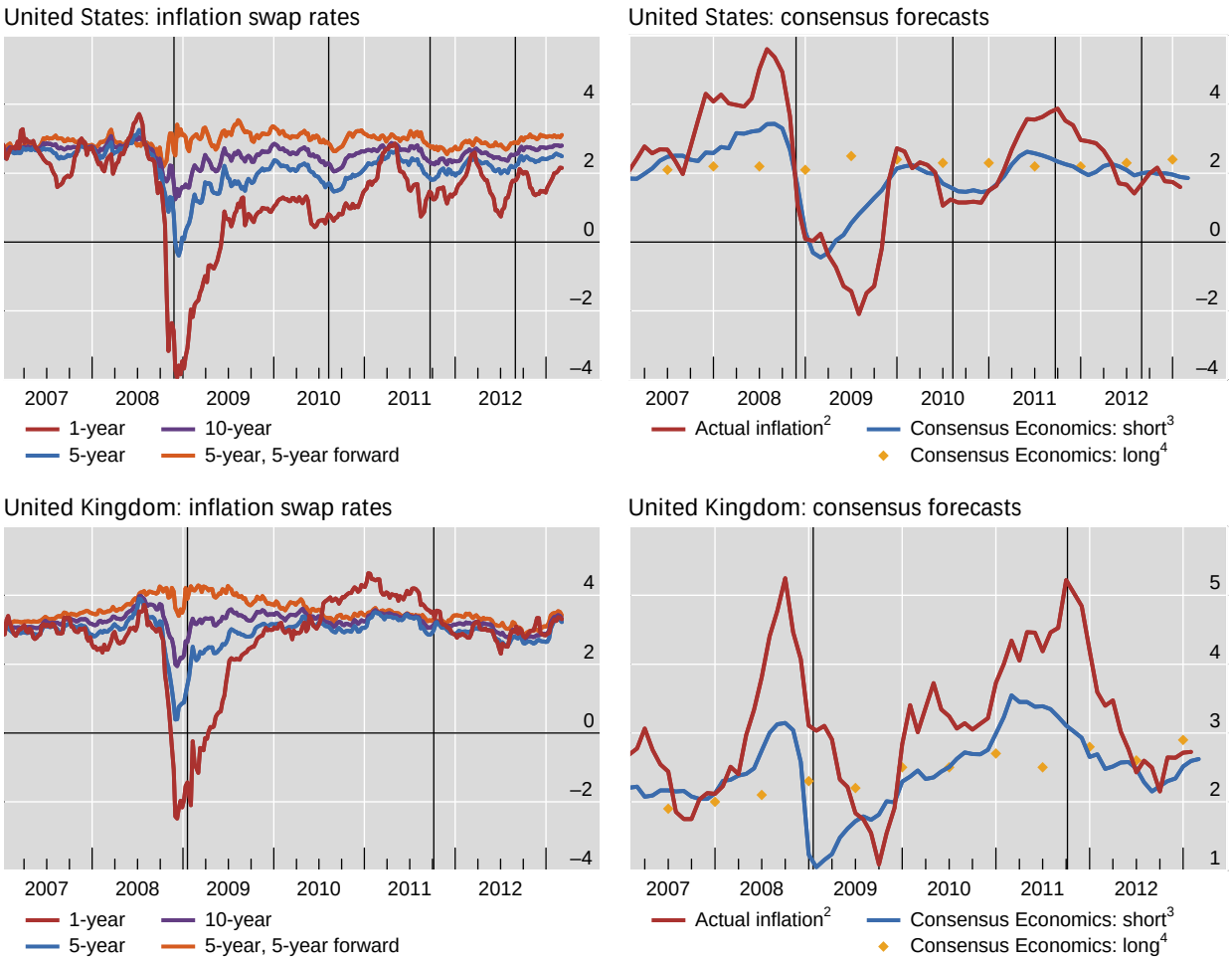
[3] A particularly complicating factor in the interpretation of break-even rates in recent years has been the significant flight-to-liquidity flows during the market turmoil and the concentration of central bank asset purchases in nominal bond markets which pushed down nominal yields and placed downward pressure on break-even rates, but also affected liquidity conditions in inflation-linked bond markets. For a more detailed discussion, see Hördahl (2009).

[4] These may comprise a liquidity premium compensating for the limited depth of inflation swap markets, a counterparty risk premium, and a premium compensating for the sellers' opportunity cost of hedging in cash markets.

[5] Consensus forecasts provide consistent measures of survey-based inflation expectations for the two countries under investigation, while national survey-based measures for the two countries are not fully comparable with respect to survey coverage and forecast horizon.

Market- and survey-based inflation expectation measures[1]

In per cent — Graph 2



[1] The vertical lines represent the dates of the first important announcement of each asset purchase programme. For the United States: 25 November 2008 (LSAP1), 10 August 2010 (LSAP2), 21 September 2011 (MEP) and 31 August 2012 (LSAP3). For the United Kingdom: 19 January 2009 (APF1) and 6 October 2011 (APF2). [2] Actual inflation is calculated as the year-on-year change in the CPI. [3] One-year-ahead CPI inflation forecast based on consensus forecasts for the current and the next year. [4] Consensus forecasts for six- to 10-year-ahead CPI inflation.

Sources: Bloomberg; © Consensus Economics; Datastream; national data; authors' calculations.

inflation expectation measures from their late 2008/early 2009 troughs. After the Lehman collapse, inflation expectation measures plunged sharply, indicating expectations of significant short-term disinflation or even deflation, which indeed temporarily materialised with actual CPI inflation dropping to –2% in the United States and 1% in the United Kingdom in mid-2009. The announcement of asset purchase programmes in late 2008 and early 2009, indicated by the first vertical line in each graph panel, preceded a rapid reversal of inflation swap rates towards pre-crisis levels in the course of 2009. Specifically, during LSAP1, US short-, medium- and long-term inflation swap rates increased by roughly 450, 210 and 140 basis points, while the equivalent UK rates increased by about 470, 170 and 70 basis points during APF1, respectively. There was a similar, though quantitatively less pronounced reversal in short-term consensus forecasts over these periods. This suggests that these first asset purchase programmes may have contributed to dispelling the most imminent concerns about deflation at that time, although the

influence of other factors such as fiscal stimulus packages, low policy rates or any other factors relevant for market sentiment is of course not controlled for.[6]

Second, subsequent asset purchase programmes were followed by more muted and mixed movements in inflation expectations. In the United States, one-, five- and 10-year inflation swap rates rose, respectively, by about 70, 70 and 60 basis points during LSAP2 and by about 20, 60 and 40 basis points during MEP and LSAP3 (until mid-January 2013). These increases, however, just kept inflation swap rates at levels near the Federal Reserve's long-run inflation goal rate of 2% announced in January 2012. UK inflation swap rates even declined by almost 40 basis points at all horizons during APF2, from levels that were nonetheless somewhat above the Bank of England's 2% inflation target. Overall, this suggests that the asset purchase programmes that were launched after the acute phase of the crisis were not associated with expectations of major future upward shifts in inflation.

Third, distant forward inflation expectations remained relatively stable during the global crisis and also after the launch of asset purchase programmes. Implied five-year, five-year forward inflation swap rates fluctuated around levels that prevailed before the crisis and that are broadly consistent with central banks' current inflation target or goal levels when taking into account the presence of inflation risk and other market premia in the inflation swap rates. Consensus forecasts of inflation six to 10 years ahead send essentially the same message, albeit displaying some greater volatility at levels above the central bank's inflation target level in the case of the United Kingdom. Overall, long-term forward inflation expectation measures remained remarkably stable in the face of significant risks of deflation in the acute phase of the crisis and the subsequent unprecedented monetary easing.

Impact of asset purchase programme announcements on inflation expectations

The apparent link identified in the previous section between the announcement of asset purchase programmes and the subsequent rebound in inflation expectation measures is, admittedly, merely suggestive. As mentioned above, such visual associations cannot disentangle the effect of asset purchases from other factors, such as fiscal and other monetary policy measures, changing economic conditions or market sentiment. In order to better isolate the impact of asset purchases on inflation expectations, we study the responses of US and UK inflation swap rates to the main announcements of the Federal Reserve and the Bank of England large-scale asset purchase programmes based on an event study approach and regression analysis.[7]

[6] Panel evidence presented by Carvalho et al (2011) suggests that the expansion of central banks' balance sheets had a significant positive effect on short-term consensus forecasts in 2009 also when fiscal stimulus measures are controlled for.

[7] We also carried out the analysis using bond market break-even rates. The results turned out to be qualitatively similar.

Event study

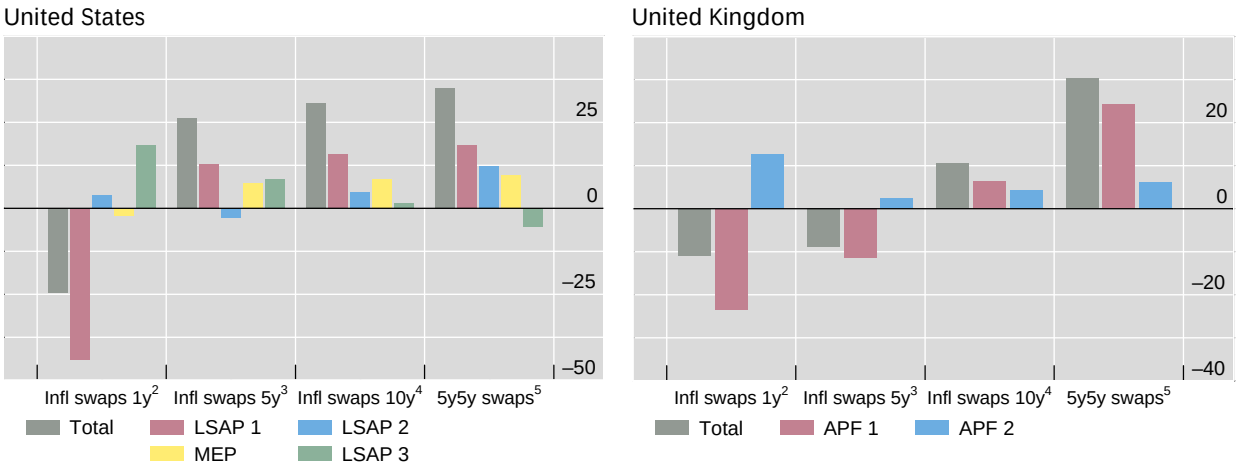
Starting with a standard event study, eg Meaning and Zhu (2011), we look at the change in inflation swap rates on the day of the main announcements of the Federal Reserve's and Bank of England's asset purchase programmes. This approach entails the assumption that financial markets would register and reflect the implications of these policy measures immediately upon their announcement.[8] The announcement dates are listed in the footnotes to Graph 3. We include official announcements with regard to the duration or size of the programmes as well as other relevant official communications, such as the Jackson Hole speech by Ben Bernanke on 31 August 2012 or the announcement by the UK Treasury on 19 January 2009 that the Bank of England would set up an Asset Purchase Facility.

We report, in basis points, the cumulative change (ie the sum of the daily changes) of inflation swap rates upon the main announcements of the individual programmes and of all programme announcements together (Graph 3). The results suggest that US and UK large-scale asset purchases had an impact on inflation swap rates, but the effects were far from uniform across maturities and programmes.

The first asset purchase programmes, LSAP1 and APF1, had a sizeable negative effect on one-year inflation swap rates, of more than 40 basis points in the United States and more than 20 basis points in the United Kingdom. This was primarily

Asset purchase announcement effects[1]

One-day event window, in basis points — Graph 3



[1] Calculated as the end-of-day value on the announcement date minus the end-of-day value on the day before the announcement. The announcement dates for the United States are those of LSAP1: 25 November 2008, 1 December 2008, 16 December 2008, 28 January 2009 and 18 March 2009; LSAP2: 10 August 2010, 27 August 2010, 21 September 2010, 15 October 2010 and 3 November 2010; MEP: 21 September 2011 and 20 June 2012; and LSAP3: 31 August 2012, 13 September 2012 and 12 December 2012. The announcement dates for the United Kingdom are those of APF1: 19 January 2009, 11 February 2009, 5 March 2009, 7 May 2009, 6 August 2009 and 5 November 2009; and APF2: 6 October 2011, 9 February 2012 and 5 July 2012. [2] One-year inflation swap rate. [3] Five-year inflation swap rate. [4] Ten-year inflation swap rate. [5] Implied five-year, five-year forward inflation swap rate.

Sources: Bloomberg; authors' calculations.

[8] The results of our analysis are qualitatively not affected when we consider a two-day instead of a one-day event window, ie when we look at the change in inflation swap rates on the day of and the day following an announcement rather than only on the announcement day.

driven by the large negative response to the very first announcements of the programmes, which were associated with a drop of 79 and 22 basis points, respectively. In the UK, medium-term inflation swap rates also fell, by 11 basis points, while a small increase of about the same magnitude was registered in that segment in the US. The impact on long-term inflation swap rates was mildly positive, with increases of roughly 16 basis points in the US and 6 basis points in the UK.[9] Overall, these findings, in particular the negative impact on short-term inflation swap rates, seem to contradict the impression given by Graph 2, which suggests that the first announcements of the purchase programmes heralded a significant recovery in inflation expectations. However, the event study merely reveals that inflation swap rates initially fell after the first announcements of LSAP1 and APF1 before starting to rise, as can also be seen from Graph 2. This suggests that market participants, to begin with, interpreted these announcements as negative news on the near-term inflation outlook before registering their stimulating effects on the economy. Alternatively, it may just reflect peculiar movements in inflation swap markets at times of acute financial and economic stress and in response to announcements of entirely novel policy measures. Or it could reflect the effect of other news on the same day the announcements were made, an aspect explored in the next section.

Subsequent asset purchase programmes generally had positive, albeit small effects on inflation swap rates. On days when there was APF2 news, UK inflation swap rates increased by 13 basis points at short horizons and less than 5 basis points at medium- and long-term horizons. In the United States, LSAP2, MEP and LSAP3 announcements taken together were associated with increases in short-term inflation swap rates of about 20 basis points and in medium- and long-term swap rates of around 15 basis points. However, the impact varied across programmes. LSAP2 and MEP announcements primarily affected long-term inflation swap rates, though by a very small amount (less than 10 basis points in the 10-year inflation swap segment). LSAP3 announcements, in contrast, were associated with a sizeable increase in short-term inflation swap rates, of about 18 basis points. This may reflect the fact that the LSAP3 announcements also captured the Federal Reserve's forward guidance on the future path of interest rates on the same days, which may have primarily impacted short-term inflation expectations.

Regression analysis

Event study-based analyses of the effects of asset purchases suffer from a number of significant drawbacks. First, over time, as markets' anticipation of announcements of asset purchase programmes improves, the estimated announcement effects may not correctly measure the true effect of the programme. Second, the effects on inflation expectations of other factors, specifically of other relevant news released on the same day as asset purchase announcements, are not controlled for. While there is little that can be done to address the first issue, we attempt to tackle the second using a high-frequency regression setup.

[9] Guidolin and Neely (2010) find somewhat larger announcement effects for LSAP1 on 10-year bond market break-even rates. When replicating the analysis with break-even rates, we arrive at a similar finding, with 10-year break-even rates increasing in total by about 30 basis points on LSAP1 announcement days.

The analytical framework follows existing high-frequency studies of the dynamics of inflation expectations (eg Gürkaynak et al (2010), Beechey et al (2011), Galati et al (2011)). We estimate regressions of the form:

$$\Delta \inf_t^E = \alpha + \beta A_t + \gamma Z_t + \varepsilon_t \quad (1)$$

where $\Delta \inf^E$ is the daily change in the inflation swap rate and A is a set of dummy variables comprising a dummy for each asset purchase announcement date. We therefore have for each individual announcement date a dummy variable that takes on the value one on the day of the announcement and zero in all other periods. Thus, we allow different announcements to have different impacts, as in the event study. Z is a set of control variables containing the surprise component of major macroeconomic data releases. Surprises are constructed by taking the difference between the released value and the value expected by market participants according to Bloomberg and JPMorgan surveys. We consider the same set of domestic macroeconomic releases as Galati et al (2011), augmented with economic releases that came out on the same day as at least one asset purchase announcement.[10] The list of releases included in *Z* is provided in the Appendix table. Finally, ε is an error term.

The regression equation is estimated on daily US and UK data over a sample period extending from the month after the Lehman collapse (ie October 2008) to mid-January 2013. The dependent variables are the one-, five- and 10-year as well as the implied five-year, five-year forward inflation swap rates. Tables 1 and 2 report the main results of the estimation of equation (1). For each regression, the table shows the impact of purchase announcements for all programmes together and for the individual programmes separately in basis points. In other words, it reports the sum of the coefficients of the announcement dummies for all

Impact of asset purchase announcements on US inflation swap rates[1] Table 1

	1-year swaps	5-year swaps	10-year swaps	5y-5y swaps
All announcements	26.75	51.95***	38.96***	25.72**
	(0.91)	(3.75)	(4.34)	(2.23)
LSAP1	15.31	36.47***	20.50***	4.23
	(0.68)	(2.65)	(2.74)	(0.52)
LSAP2	11.05	–0.06	8.46***	17.08***
	(1.13)	(–0.02)	(3.28)	(4.57)
MEP	–6.50	5.74***	7.45***	9.17***
	(–1.61)	(6.05)	(8.76)	(6.81)
LSAP3	6.89	9.80***	2.56	–4.76
	(1.05)	(3.79)	(1.01)	(–1.10)

***/**/* indicates significance at the 1/5/10% level. The announcement dates are those of LSAP1: 25 November 2008, 1 December 2008, 16 December 2008, 28 January 2009 and 18 March 2009; LSAP2: 10 August 2010, 27 August 2010, 21 September 2010, 15 October 2010 and 3 November 2010; MEP: 21 September 2011 and 20 June 2012; and LSAP3: 31 August 2012, 13 September 2012 and 12 December 2012.

[1] In basis points, with autocorrelation- and heteroskedasticity-robust *t*-statistics in parentheses.

[10] We also consider the inclusion of the US releases in the UK regressions, but find this not to affect the results qualitatively.

Impact of asset purchase announcements on UK inflation swap rates[1] Table 2

	1-year swaps	5-year swaps	10-year swaps	5y-5y swaps
All announcements	–8.81	–6.81***	11.87***	30.78***
	(–1.99)	(–3.71)	(7.05)	(11.93)
APF1	–25.02***	–10.00***	7.52***	25.26***
	(–9.10)	(–7.87)	(6.22)	(14.20)
APF2	16.21***	3.19***	4.35***	5.52***
	(6.49)	(3.98)	(5.93)	(4.11)

***/**/* indicates significance at the 1/5/10% level. The announcement dates are those of APF1: 19 January 2009, 11 February 2009, 5 March 2009, 7 May 2009, 6 August 2009 and 5 November 2009; and APF2: 6 October 2011, 9 February 2012 and 5 July 2012.

[1] In basis points, with autocorrelation- and heteroskedasticity-robust *t*-statistics in parentheses.

programmes together and for the individual programmes. In parentheses, we report autocorrelation- and heteroskedasticity-robust *t*-statistics of the coefficients.

The main findings of the regression analysis are twofold. First, the estimated impacts of asset purchase announcements are in general consistent with those of the event study. An important exception is the impact of LSAP1 announcements in the United States, which is estimated to have raised one-, five- and 10-year inflation swap rates by roughly 15, 35 and 20 basis points, respectively. This suggests that the smaller impacts found for LSAP1 announcements in the event study, which in the case of short-term inflation swap rates were even sizeably negative, partly reflect the effects of other macroeconomic news included in the set of control variables *Z*.

Second, the *t*-statistics reveal that the impacts of purchase announcements have mostly been statistically significant. Only the estimated impact on short-term inflation swap rates in the United States is statistically insignificant for all programmes. In addition, LSAP2 did not have a significant impact on five-year inflation swap rates, while LSAP3 did not significantly affect the 10-year rates.

Overall, the analysis suggests that asset purchase announcements had economically and statistically significant positive effects only on medium- and long-term inflation swap rates in the United States. The estimated cumulative impact of all asset purchase announcements on US five- and 10-year inflation swap rates is roughly 50 and 40 basis points, respectively. In the United Kingdom, there is a relatively large cumulative increase in five-year, five-year forward inflation swap rates, but this reflects the oppositely signed impact of the announcements on the five- and 10-year swap rates.

Conclusions

The analysis in this article indicates that the effects of the large-scale asset purchases by the Federal Reserve and Bank of England on inflation expectations have been statistically significant, but that their quantitative importance is uncertain. In the course of the various asset purchase programmes, in particular after the initial programmes launched in late 2008 and early 2009, inflation

expectation measures displayed sizeable rebounds towards levels broadly consistent with central banks' inflation target levels. This suggests that asset purchase programmes have made an important contribution to fending off deflation risks. However, an assessment of the impact of the major programme announcements indicates economically and statistically significant effects only for medium- and long-term inflation swap rates in the United States. This may imply that factors other than asset purchase programmes were the main driving factor behind the shifts in inflation expectation measures over the course of the crisis and post-crisis period. Alternatively, the effects of asset purchase programmes may not be appropriately captured by announcement effect analysis, eg because the programmes were anticipated or affected expectations with longer lags, possibly in interaction with other factors such as changing economic sentiment.

References

Beechey, M, B Johannsen and A Levin (2011): "Are long-run inflation expectations more firmly anchored in the Euro Area than the United States?", *American Economic Journal, Macroeconomics*, vol 3 (2), pp 104–29.

Carvalho, C, S Eusepi and C Grisse (2011): "Unconventional policies during the crisis and expectations of inflation and growth: a cross-country analysis", *Working Paper*, Federal Reserve Bank of New York.

Chen, Q, A Filardo, D He and F Zhu (2012): "International spillovers of central bank balance sheet policies", *BIS Papers*, no 66, pp 220–64.

Galati, G, S Poelhekke and C Zhou (2011): "Did the crisis affect inflation expectations?", *International Journal of Central Banking*, vol 7 (2), pp 167–207.

Gambacorta, L, B Hofmann and G Peersman (2012): "The effectiveness of unconventional monetary policy at the zero lower bound: a cross-country analysis", *BIS Working Papers*, no 384.

Gerlach, P, P Hördahl and R Moessner (2011): "Inflation expectations and the great recession", *BIS Quarterly Review*, March, pp 39–51.

Guidolin, M and C Neeley (2010): "The effects of large-scale asset purchases on TIPS inflation expectations", *Economic Synopsis 2010*, no 26, Federal Reserve Bank of St Louis.

Gürkaynak, R, A Levin and E Swanson (2010): "Does inflation targeting anchor long-run inflation expectations? Evidence from the US, UK and Sweden", *Journal of the European Economic Association*, vol 8 (6), pp 1208–42.

Hördahl, P (2009): "Disentangling the drivers of recent shifts in break-even inflation rates", *BIS Quarterly Review*, March, pp 10–11.

Meaning, J and F Zhu (2011): "The impact of recent central bank asset purchase programmes", *BIS Quarterly Review*, December, pp 73–83.

—— (2012): "The impact of Federal Reserve asset purchase programmes: another twist", *BIS Quarterly Review*, March, pp 23–32.

Reynard, S (2012): "Assessing potential inflation consequences of QE after financial crises", *Peterson Institute for International Economics Working Paper*, pp 12–22.

Thornton, D (2012): "Quantitative easing and money growth: potential for higher inflation?", *Economic Synopsis*, no 4, Federal Reserve Bank of St Louis.

Woodford, M (2010): "Bernanke needs inflation for QE2 to set sail", *Financial Times*, 11 October.

Wright, J (2012): "What does monetary policy do to long-term interest rates at the zero lower bound?", *The Economic Journal*, vol 122, issue 564, pp F447–66.

Appendix

Economic releases included in the regressions

Appendix Table

US economic releases	Release on announcement dates (Y/N)	UK economic releases	Release on announcement dates (Y/N)
Chicago Business Barometer	Y	Manufacturing PMI Markit Survey	N
Census Bureau US Construction Spending MoM	Y	Avg Earnings Whole Economy Headline Rate 3 Month Average	Y
Conference Board Consumer Confidence	Y	Bank of England Official Bank Rate	Y
University of Michigan Survey of Consumer Confidence Sentiment	Y	Chained GDP at Market Prices QoQ	N
Unit Labor Costs Nonfarm Business Sector QoQ	Y	Halifax House Prices All UK MoM	Y
CPI Urban Consumers MoM	Y	Industrial Production MoM	Y
Capacity Utilization Per cent of Total Capacity	N	IOS Index Total Service Industries MoM	Y
Empire State Manufacturing Survey General Business Conditions	Y	Manufacturing Production MoM	Y
Existing Homes Sales	Y	Nationwide Consumer Confidence Index	N
Treasury Federal Budget Debt Summary Deficit Or Surplus	Y	PPI Manufactured Products MoM	N
Federal Funds Target Rate	Y	CPI EU Harmonized MoM	N
GDP Chained 2005 Dollars QoQ	Y	UK RPI MoM	N
GDP Personal Consumption Core Price Index QoQ Per cent	Y	Unemployment Claimant Count Monthly Change	Y
Import Price Index by End Use All MoM	Y	Claimant Count Rate	Y
Initial Jobless Claims	Y		
Industrial Production MoM 2007 = 100	N		
Conference Board US Leading Index MoM	N		
ISM Non-Manufacturing NMI	Y		
ISM Manufacturing PMI	Y		
New One Family Houses Sold Annual Total	Y		
New Privately Owned Housing Units Started by Structure Total	Y		
Personal Consumption Expenditure Core Price Index MoM	N		
PPI By Processing Stage Finished Goods Total MoM	Y		
Richmond Federal Reserve Manufacturing Survey Monthly Per cent Change Overall Index	Y		
Adjusted Retail & Food Services Sales Total Monthly Per cent Change	Y		
Adjusted Retail Sales Less Autos Monthly Per cent Change	Y		
NFIB Small Business Optimism	Y		
S&P/Case-Shiller Composite-20 City Home Price Index YoY	Y		
Manufacturers' New Orders Total MoM	Y		
Employees on Nonfarm Payrolls Total MoM Net Change	N		
Unemployment Rate Total in Labor Force	N		

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Financial conditions and economic activity: a statistical approach[1]

How do conditions in the financial sector affect the macroeconomy? We summarise the common variation in a large array of financial variables into a small set of statistical factors and examine the information content of these factors when forecasting GDP and inflation in four economies. We find that financial factors contain information that is independent of and complementary to that in real variables. This information accounts for a larger proportion of the movement in real and nominal GDP, but a smaller proportion of the variability of inflation.

JEL classification: G00, C65, C530.

Macroeconomists have often taken a simplistic approach to addressing the interactions between the financial sector and the real economy. Models that incorporate financial variables rarely venture beyond the yield curve and/or the price of assets such as equity or property. However, as the experience of the recent crisis underscored, the channels of transmission between the real and financial sectors can be very strong and diverse, working through asset prices as well as the balance sheets of financial institutions, households and firms. Thus, the identification of stable patterns in the joint dynamics of the real and financial sectors could provide the basis for improving our understanding of the mechanisms at work.

This article examines lead-lag statistical relationships between financial and real sector variables. No specific economic model underpins the exercise. Rather the idea is to outline the connections between a wide array of financial variables and two key macro variables: GDP and inflation. To do so, we extract a small set of factors that summarise conditions in the financial sector and select those with the highest information content for forecasting the real variables. Based purely on statistical criteria, the selection is intended simply to establish stylised empirical regularities about the dynamic links between the two sets of variables. There is no attempt to explain or characterise them. Our approach adds to the literature by examining the information content of a large group of variables in the context of output and inflation and for a number of countries.

Our results show that, consistently across countries, financial factors do contain information about macroeconomic variables. This is most evident in the case of

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output. The inclusion of financial factors and their lags in the forecasting equations for real and nominal GDP growth significantly improves their explanatory power compared to using past values of real variables only. The financial factors also improve the fit of the forecasting regressions for inflation, but their contribution is weaker.

The rest of the article consists of four sections. The first section introduces the exercise with reference to the existing research literature on the relationship between macroeconomic activity and financial sector variables. The second section is methodological, and describes the statistical approach we use for the construction of the financial factors. The third section presents the results of the forecasting regressions and discusses the contribution of the financial factors to GDP and inflation. The concluding section outlines the points that could be taken up in future research.

Financial conditions and the real economy

Historically, macroeconomic modelling abstracted from financial sector activity, focusing primarily on the interactions of real variables such as GDP, prices, unemployment and components of aggregate expenditure. Money and interest rates were the main financial variables used in models as they related to the stabilisation tools available to central banks. Even these variables were omitted in descriptions of macroeconomic dynamics provided by the real business cycle literature.[2]

This modelling shortcut does not mean that economists have disregarded the influence of financial factors in shaping macroeconomic outcomes. On the contrary, several important works have focused on the interactions between the business and financial cycles, albeit adopting a narrative rather than a formally quantitative approach. The works of Kindelberger and Minsky are cases in point. That said, macroeconomists have yet to converge on a set of key variables that summarise the financial sector's behaviour. The resulting lack of parsimony stands in the way of empirical or theoretical modelling, representing a stumbling block to further quantitative analysis.

Yet a number of empirical exercises use financial variables to forecast real sector developments. Motivated by the observation that financial contracts are forward-looking and that asset prices reflect market participants' expectations about the future, research has looked into variables that can help to predict future changes in the real economy. Another practical advantage of financial variables, especially asset prices, is that they are observed in real time. The literature focuses on the role of interest rates and asset prices in explaining developments in output and inflation (Goodhart and Hofmann (2000)). The term structure is used as the predictor of economic activity in Estrella and Hardouvelis (1991) and for inflation in Mishkin (1991). The interest rate spread between risky and safe debt issues was used by Friedman and Kuttner (1992). Researchers have also examined the information content of financial variables other than prices for economic activity. For example, Borio and Lowe (2002) looked at bank credit, while Kashyap et al (1993) examined shifts in the composition of credit to the private sector from banks

[2] Two seminal papers in this strand of the literature are Kydland and Prescott (1982) and Long and Plosser (1983).

and market sources as a gauge of the tightness of credit conditions that can affect future output.

The recent crisis has given new impetus to efforts to include a substantial financial sector in macroeconomic models (see Borio (2011) for a discussion). Recently the literature has focused on changes in the monetary transmission mechanism. It assumes that monetary conditions influence the real sector by affecting the financial conditions that have direct links to economic behaviour. For example, Boivin et al (2009) and Gertler and Karadi (2010) study unconventional monetary policies in models that incorporate financial intermediaries. Gertler and Kiyotaki (2010), and Christiano et al (2011) study the influence of financial sector activity in shaping the business cycle.

Our work is also closely related to a budding literature on how indicators for financial conditions might be devised. With the aim of developing metrics for financial stability, researchers have proposed different indicators of varying composition and complexity that summarise aspects of financial sector activity. Examples include Bordo et al (2000), Illing and Liu (2006) and Holló et al (2012). Our approach follows closely, and expands, the work of English et al (2005) and Hatzius et al (2010).

As those papers do, we follow Stock and Watson (2002) in condensing the common components in the dynamics of a large group of financial sector variables into a small set of statistical principal components (factors) and then use these to forecast economic activity variables at a one- to two-year horizon.

In contrast to most of the financial conditions literature, we firmly link the financial factors to future developments in the real economy. This is motivated by our interest in highlighting the interactions between the two sectors, an area of inquiry that remains underdeveloped in current macroeconomic analysis despite its importance for monetary and financial stability policy. We also draw lessons from the common features of the results across four countries with a view to adding robustness to the analysis.

Construction of financial factors

The approach we adopt in this article is purely statistical. The absence of an established formal model that describes the workings of the financial sector would rule out a structural empirical investigation of the interactions with the real sector. Instead, our atheoretical approach condenses the information content of a broad array of variables into a set containing a few representative factors that could then be feasibly used in a forecasting exercise. Starting with a wide array of financial variables gives ample room to select the more pertinent relationships between real and financial variables. The forecasting framework sets the criterion for this selection. It assigns a premium to those factors that have the closest relationship with future macroeconomic developments.

The construction method for these factors follows Stock and Watson (2002). It relies on principal components analysis (PCA) to distil the common movements in a large array of variables into a small set of uncorrelated factors. The input to the PCA is a set of normalised variables. The box gives more detail on the preparatory work for the financial sector variables that enter the PCA. These variables are then

Principal component analysis on an unbalanced panel with mixed frequencies

PCA requires that the input data series have certain properties. Variables must be stationary (ie without deterministic or stochastic trends), they should be of a comparable range of variation (ie have similar means and volatilities), and they should be defined over a common range of dates. Not all the original series we use (see Web Appendix for a list) fulfil these criteria. Most series are quarterly, but a few are observed only annually. Most series start in 1980 but some begin later. Finally, there is considerable variation across variables in terms of their units and amplitude. We deal with these problems through a series of adjustments that are fairly standard in the literature.

As a starting point, all the series are checked for stationarity by performing a battery of unit root tests: these are the Philips-Perron test, as well as autoregressive and trend-stationary Augmented Dickey-Fuller tests. The lag choice for the tests is based on the procedure suggested by Ng and Perron (1995) and the rule-of-thumb suggested by Schwert (1989). The variables that exhibit unit roots are then differenced in the final set. All variables are normalised by dividing by their standard deviation.

In order to fill in missing observations due to the use of annual series or to extrapolating quarterly series beyond their observed range, we apply the EM algorithm proposed by Stock and Watson (2002). The algorithm is embedded in the process estimating the PCs and it comprises two steps. The first step involves the linear projection (regression) of those variables with missing observations on a balanced panel of PCs estimated on the basis of the quarterly series observed over the entire sample period. This projection is used in the second step to fill in the missing observations before a new set of PCs is estimated on the basis of the complete and projected series. The procedure is repeated until the process converges, namely the subsequent estimates of PCs are sufficiently close between iterations. In our case, this occurred after four to five iterations. As prescribed in Stock and Watson (2002), the details of the algorithm are slightly different depending on whether the interpolated series refers to a stock or flow variable, and whether it is in levels or first differences.

The final, balanced panel of variables at a quarterly frequency together with a one-quarter lag was used to calculate a final set of factors that were used in the forecasting exercise for the real variables. Stock and Watson (2002) argue that the inclusion of a one-period lag can go some way towards capturing the time dynamics of the financial variables in the estimated factors.

transformed into a set of uncorrelated variables: the principal components (PCs), or factors as we alternatively refer to them below. By construction, the number of estimated PCs can be as high as the number of the initial set of (correlated) financial variables. Since, by construction, the PCs are ordered in declining importance in terms of their ability to capture the overall variability in the group of input variables, we focus only on the first few that capture the bulk of this variability.

The approach in this paper has similarities also with the weighted average approach used by Dudley et al (2005) or Guichard and Turner (2008). They construct an indicator of financial conditions as the weighted sum of several financial variables with weights that reflect their relative impact on real GDP. A key difference with our paper is that they obtain the weights on the basis of simulations using large macroeconomic or vector-autoregressive models.

We conduct our exercise for four countries: Canada, Germany, the United Kingdom and the United States. For each country we collected around 90 financial variables that belong to different groups (see the Web Appendix for a detailed list of the variables). We group them into four categories: (i) interest rates and spreads; (ii) asset prices; (iii) credit and debt aggregates; and (iv) indicators of performance for the banking system.

The interest rate category includes short- and long-term interest rates on government and private sector bonds, as well as interest rate spreads that capture credit and liquidity risk premia. These measure primarily the cost of borrowing for

consumers and investors but also reflect expectations about future inflation and the monetary policy stance.

The asset prices category includes the total return of the general stock price index as well as a financial sector sub-index, and the growth of residential and commercial property prices. There are several channels through which asset prices can be connected to future real sector developments. One channel reflects the fact that they embody market participants' collective information and expectations about future macroeconomic developments. By contrast, the credit channel has a more causal impact on aggregate demand as higher asset prices increase the borrowing capacity of households and corporates, helping to support higher levels of expenditure. Finally, higher asset prices increase wealth, which arguably leads to increased consumption through the wealth channel.

Credit and debt aggregates include measures of credit to households, the government and non-financial corporations. Increases in credit often precede increases in fixed investment and thus growth. In addition, periods of booming credit typically go hand in hand with optimism on the part of economic decision-makers and with positive attitudes towards risk-taking that fuel investment and consumption. We include in this category credit extended by banks to various sectors and for various purposes (consumer credit, mortgages etc).

The category of banking system performance indicators includes measures of the financial health of the banking system, based on banks' balance sheet and income statements. We include also profitability metrics such as net interest margins, return on equity and on assets, as well as capitalisation ratios.

By construction, the estimated factors are mutually uncorrelated and are ranked in reverse order of their ability to capture the overall variance of the broad dataset of financial variables (see Table 1). Among the four countries in our analysis, three exhibit a similar pattern in terms of the importance of the first few factors. In the United States, Germany and Canada, the first factor explains about one seventh of the total variance, with the proportion falling gradually to about one twentieth for the fifth factor. The first five factors explain about half of the total variance while the next five add a little less than 20%. The pattern in the United Kingdom is slightly different as the first three factors (and the first one in particular) have greater information content. As a result, the explanatory power in terms of overall variance of the first five and 10 factors is about 10 percentage points stronger than for the other three countries. We have no obvious explanation for this difference.

Financial factors – percentage of total variance explained Table 1

	United States	Germany	Canada	United Kingdom
First factor	13.5	15.1	15.2	23.0
Second factor	12.2	8.6	11.3	14.2
Third factor	8.9	8.1	8.2	9.9
Fourth factor	7.6	7.3	6.5	7.9
Fifth factor	5.6	6.7	6.0	4.9
First 10 factors	68.5	65.9	68.8	76.3

Source: Authors' calculations.

Information content of financial factors for real sector

Forecasting regressions with four-quarter horizon; quarterly data 1980–2011 Table 2

	United States			United Kingdom			Germany			Canada		
Variables	Real GDP growth	Nominal GDP growth	Inflation	Real GDP growth	Nominal GDP growth	Inflation	Real GDP growth	Nominal GDP growth	Inflation	Real GDP growth	Nominal GDP growth	Inflation
GDP_t	1.82 (4.94)	2.18 (5.11)	0.44 (3.00)	1.57 (4.34)	4.04 (7.76)		3.10 (4.65)	3.67 (5.08)	0.54 (1.74)	1.98 (3.64)	0.68 (0.85)	0.42 (5.88)
GDP_{t-1}	–1.99 (–4.29)	–2.13 (–4.14)	–0.19 (–1.10)	–1.62 (–3.82)	–5.96 (–6.24)		–4.57 (–4.00)	–5.55 (–4.63)	–0.83 (–1.67)	–1.95 (–3.48)	–0.76 (–0.65)	
GDP_{t-2}					2.74 (5.36)		1.70 (2.78)	2.29 (3.92)	0.37 (1.47)		0.18 (0.27)	
GDP_{t-3}												
GDP_{t-4}	1.56 (4.97)	1.47 (3.84)		1.16 (3.01)						1.60 (3.78)		
GDP_{t-5}	–1.19 (–4.90)	–0.84 (–2.55)		–0.79 (–2.62)						–1.24 (–3.91)	0.08 (0.65)	
$INFL_t$	–1.54 (–3.10)	–2.05 (–3.74)	1.01 (2.89)		–0.30 (–4.16)	1.81 (3.51)			1.70 (6.61)	–0.22 (–1.53)	–1.18 (–1.84)	1.65 (5.85)
$INFL_{t-1}$	1.67 (3.11)	2.36 (3.99)	–0.68 (–1.74)			–1.81 (–1.84)			–1.28 (–4.64)		1.23 (2.25)	–1.22 (–3.92)
$INFL_{t-2}$				–0.42 (–1.62)		0.69 (1.15)				0.22 (1.72)		
$INFL_{t-3}$				0.33 (1.46)								
$INFL_{t-4}$	–1.66 (–3.37)	–2.39 (–3.95)		0.96 (2.29)								1.21 (3.19)
$INFL_{t-5}$	1.26 (3.28)	1.92 (3.97)		–0.65 (–2.54)		–0.14 (–1.14)			0.13 (1.41)			–0.81 (–2.74)
$FF1_t$	–0.28 (–3.95)	–0.26 (–3.42)		–0.53 (–2.61)		1.15 (3.95)				–0.23 (–5.06)	–0.62 (–6.36)	
$FF1_{t-1}$				–1.13 (–2.81)	–0.06 (–4.84)	2.28 (3.92)				0.26 4(.74)	0.28 (2.09)	
$FF1_{t-2}$				–1.28 (–3.24)		1.18 (3.90)			–0.04 (–2.17)			
$FF1_{t-3}$	0.19 (2.76)	0.19 (2.72)		–0.66 (–3.49)								0.11 (3.83)
$FF2_t$	–0.15 (–4.26)	–0.20 (–3.97)	–0.12 (–3.59)		–0.42 (–4.99)	–0.58 (–5.08)	0.80 (4.66)	0.92 (4.84)				
$FF2_{t-1}$	0.10 (2.09)						–0.41 (–3.51)	–0.45 (–2.96)				
$FF2_{t-2}$										–0.15 (–3.60)		0.12 (4.49)
$FF2_{t-3}$		0.13 (2.43)	0.11 (3.26)	–0.29 (–4.20)	0.27 (4.57)	0.72 (4.94)						
$FF3_t$				–0.59 (–2.85)	–0.13 (–3.08)	0.91 (3.28)						
$FF3_{t-1}$							–0.35 (–3.51)	–0.32 (–3.61)				
$FF3_{t-2}$						–1.32 (–4.19)						
$FF3_{t-3}$	–0.15 (–2.05)		0.09 (1.87)	0.74 (3.74)					0.08 (3.06)		–0.09 (–1.52)	
$FF4_t$				0.17 (1.99)		0.41 (4.19)				–0.18 (–4.14)	–0.35 (–4.32)	
$FF4_{t-1}$						–0.34 (–3.94)	–0.28 (–2.96)	–0.40 (–3.13)			0.27 (2.68)	
$FF4_{t-2}$										–0.08 (–2.11)		
$FF4_{t-3}$	–0.12 (–4.01)			–0.12 (–2.23)					–0.08 (–3.02)			
R^2 adj	0.79	0.79	0.84	0.78	0.92	0.86	0.72	0.79	0.74	0.76	0.61	0.85

Source: Authors' calculations.

Statistical links between real and financial sectors

The idea behind the forecasting exercise is to identify the factors that have the greatest information content for the future dynamics of the three macroeconomic variables we analyse: real and nominal GDP growth, and inflation. We set up equations of the following form over the period 1980–2011:

$$y_{t+k} = \sum_{i\in\{0,\dots,5\}} a_i y_{t-i} + \sum_{i\in\{0,\dots,5\}} \beta_i x_{t-i} + \sum_{I\in[1,\dots,n]} \sum_{i\in\{0,\dots,n\}} \gamma_{I,i} F_{I,t-i} + \varepsilon_{t+k} \ ,$$

where the variable to be forecast is either real GDP growth, nominal GDP growth or inflation over a four- or eight-quarter horizon (ie k is equal to either 4 or 8). There are two groups of predictors. The first group consists of current and lagged values of GDP growth and inflation, which provide the benchmark for the information content of the financial factors. We based the selection of the lags in each group of predictors on a procedure that balances the regression's goodness of fit, on the one hand, with parsimony, measured by the number of explanatory variables, on the other hand. This balance is achieved by minimising the Bayesian Information Criterion (BIC) due to Schwartz (1978).

The second group of predictors is selected among the financial variables and their lags. The selection is based on the same statistical criterion as the selection of the real set of predictors but treating the latter set as fixed. In other words, different combinations of the financial factors and their lags are added as additional predictors to the best specification that includes only real sector variables. We then select the model with the lowest BIC. That is the specification that offers the best balance between forecasting ability and parsimony.

The choice of forecast horizon corresponds to the typical horizon used in policy. In order to reduce noise coming from the high-frequency dynamics of the macro variables, we use four-quarter averages as the dependent variable.

Empirical results

Tables 2 and 3 present the results of the final forecasting regressions characterised by the lowest BIC. Each table shows results for all four countries and for the three macro variables. Table 2 refers to the one-year forecast horizon and Table 3 to the two-year horizon.

A number of patterns emerge from looking at the results across countries and forecasted variables. The performance of forecasting regressions is overall quite good, although it deteriorates as expected at the longer horizon. For the four-quarter horizon the adjusted R^2 ranges between 72% and 92%, with the exception of the Canadian nominal GDP growth regression, where it is only 61%. For the eight-quarter horizon the range is 31% to 88%, with the exception of the same variable as before, for which it is a very low 5%.

In all cases, the financial factors do have information content for future values of the macroeconomic variables. They enter the forecasting regressions at conventional significance levels contributing to the fit of the forecasting regression. Generally, when we forecast real and nominal GDP growth, more factors enter the regressions with multiple lags, therefore showing that factors do have a lagged and more complex influence on the variables. Regressions for inflation typically contain fewer financial factors and very often each factor enters only with one lag.

Information content of financial factors for real sector

Forecasting regressions with eight-quarter horizon; quarterly data 1980–2011 Table 3

	United States			United Kingdom			Germany			Canada		
Variables	Real GDP growth	Nominal GDP growth	Inflation	Real GDP growth	Nominal GDP growth	Inflation	Real GDP growth	Nominal GDP growth	Inflation	Real GDP growth	Nominal GDP growth	Inflation
GDP_t				0.17 (1.12)	0.71 (4.68)			–0.42 (–2.39)	0.36 (1.83)		–0.7 (–0.83)	1.24 (5.47)
GDP_{t-1}	–0.13 (–0.77)								–0.35 (–1.59)		0.73 (0.65)	–1.13 (–4.27)
GDP_{t-2}											–0.21 (–0.36)	
GDP_{t-3}												0.58 (5.87)
GDP_{t-4}						0.31 (1.61)						
GDP_{t-5}					0.57 (3.23)				0.03 (0.36)	–0.31 (–2.67)	–0.07 (–0.29)	
$INFL_t$	–2 (–3.65)			–0.52 (–2.69)	–1.06 (–4.14)		–0.17 (–0.68)		0.04 (0.36)		–0.9 (–0.81)	0.51 (3.81)
$INFL_{t-1}$	2.13 (3.36)										1.2 (1.42)	
$INFL_{t-2}$												
$INFL_{t-3}$												
$INFL_{t-4}$	–2.65 (–3.99)	–1.34 (–2.96)										
$INFL_{t-5}$	2.17 (4.68)	1.47 (3.3)	0.09 (2.06)	0.3 (2.24)		0.15 (1.43)						0.14 (1.62)
$FF1_t$		–0.28 (–2.18)								0.23 (3.98)	–0.15 (–0.9)	
$FF1_{t-1}$											–0.04 (–0.25)	
$FF1_{t-2}$		0.32 (1.93)						–0.22 (–2.58)	–0.08 (–3.24)			0.08 (2.59)
$FF1_{t-3}$										–0.18 (–3.32)		
$FF2_t$			–0.07 (–1.44)	–0.18 (–1.8)	–0.17 (–2.07)	–0.13 (–1.35)	0.52 (2.8)	0.73 (3.08)				
$FF2_{t-1}$										–0.41 (–4.71)		
$FF2_{t-2}$												
$FF2_{t-3}$	–0.23 (–2.62)						–0.45 (–2.73)					0.09 (2.58)
$FF3_t$							0.36 (3.04)					
$FF3_{t-1}$		–0.28 (–2.12)							0.07 (3.04)			0.07 (2.3)
$FF3_{t-2}$									0.1 (3.74)	0.15 (1.94)		
$FF3_{t-3}$	–0.26 (–1.8)						–0.17 (–1.86)		0.07 (2.9)		–0.04 (–0.37)	0.13 (3.59)
$FF4_t$							–0.27 (–1.84)			–0.19 (–3.77)	–0.07 (–0.71)	
$FF4_{t-1}$								–0.54 (–2.62)	–0.11 (–3.67)	–0.12 (–1.84)	0.09 (0.74)	
$FF4_{t-2}$		–0.15 (–2.44)										0.09 (2.82)
$FF4_{t-3}$					–0.13 (–1.89)					–0.2 (–2.96)		
R^2 adj	0.52	0.49	0.74	0.31	0.75	0.66	0.33	0.41	0.69	0.57	0.05	0.88

Source: Authors' calculations.

To assess the information content of each group of variables, we have calculated two statistics. The first is due to Hellwig (1982) and it provides a measure of the contribution to the explanatory power of a regression by subgroups of regressors based on correlations across these variables and correlation with dependent variable. The second is a metric of the reduction in the sum of squared regression residuals achieved by the inclusion of a group of variables. It is the ratio of the gain in terms of a reduction in the sum of squared residuals of the regression that results from the addition of the given group of variables, and the sum of squared residuals of the regression that excludes that group. Both statistics were calculated separately for the group of real variables and the group of the selected financial factors for the optimal regression specification. A higher value of the statistic would imply a higher contribution of the specific group in explaining the future dynamics of the macroeconomic variable.

The results for both forecast horizons are shown in Tables 4 and 5. They highlight two key points for our analysis. The first point is that financial factors have overall as much explanatory power as lagged real variables. This result is strongest for the two GDP variables, for which the Hellwig statistic (Table 4) is practically unanimous across countries and forecast horizons. For inflation, the case is weaker. Financial variables make a stronger contribution to the forecasting exercise than financial variables at the two-year horizon, but the opposite is true for the one-year prediction. Moreover, it seems that the forecasting ability of financial factors is generally weak for Canadian inflation at both horizons. The second point that emerges from the comparison of the Hellwig statistics is that the overall predictive strength of the regressions is weaker for the longer-horizon forecasts; the ability of the financial factors is less affected than that of the real variables. The statistics that relate to the real variables deteriorate much faster with the forecast horizon than those relating to the financial variables, pointing to the possibility that the influence of financial factors on macroeconomic developments may have a longer fuse.

Relative information content of real and financial variables

In percentage points of total explanatory power of forecast regression — Table 4

	Four-quarter forecasting horizon											
	United States			United Kingdom			Germany			Canada		
Variables	Real GDP	Nominal GDP	Inflation	Real GDP	Nominal GDP	Inflation	Real GDP	Nominal GDP	Inflation	Real GDP	Nominal GDP	Inflation
Real	12.1	12.9	38.4	15.9	45.1	42.2	7.9	23.7	39.3	7.2	5.4	46.5
Financial	40.2	32.6	20.3	25.3	64.2	29.5	25.9	46.2	22.4	45.4	29.8	6.4
	Eight-quarter forecasting horizon											
	United States			United Kingdom			Germany			Canada		
Variables	Real GDP growth	Nominal GDP growth	Inflation	Real GDP growth	Nominal GDP growth	Inflation	Real GDP growth	Nominal GDP growth	Inflation	Real GDP growth	Nominal GDP growth	Inflation
Real	3.3	17.6	7.6	3.6	23.9	6.0	1.4	5.4	15.9	4.7	2.6	27.4
Financial	24.1	17.0	8.9	15.0	48.4	22.6	11.5	24.8	40.3	14.5	0.5	7.4

Note: The table shows the value of the integral capacity of a set of predictors proposed by Hellwig (1968). The value of this metric corresponds to the percentage of the overall variation of the forecasted variable that is accounted for by a given set of the predictor variables.

Source: Authors' calculations.

Relative contribution to explanatory power of regression

In percentage points of unexplained residual

Table 5

	Four-quarter forecasting horizon											
Per cent	United States			United Kingdom			Germany			Canada		
Variables	Real GDP	Nominal GDP	Inflation	Real GDP	Nominal GDP	Inflation	Real GDP	Nominal GDP	Inflation	Real GDP	Nominal GDP	Inflation
Real	45.9	37.9	14.9	55.9	47.4	48.2	35.5	41.0	22.5	50.1	42.6	38.1
Financial	50.0	54.6	62.1	39.2	61.4	57.2	45.2	44.0	59.1	40.3	12.2	72.4
	Eight-quarter forecasting horizon											
Per cent	United States			United Kingdom			Germany			Canada		
Variables	Real GDP	Nominal GDP	Inflation	Real GDP	Nominal GDP	Inflation	Real GDP	Nominal GDP	Inflation	Real GDP	Nominal GDP	Inflation
Real	23.6	23.5	5.7	16.1	21.0	8.1	36.7	39.9	37.4	54.5	4.3	52.8
Financial	32.8	16.7	33.5	26.7	35.3	25.0	1.3	10.7	7.3	14.9	7.4	71.3

Note: The values refer to the difference between the sum of squared regression residuals of the full regression and that of a regression that excludes the variables corresponding to the specific row, divided by the latter figure. A higher value for the ratio indicates a higher information content.

Source: Authors' calculations.

A gauge of financial conditions?

The form of the forecasting regressions lends itself to another interpretation of the results. The linear combination of the financial factors can also be seen as a gauge of financial conditions. Taken literally, it represents the specific combination of financial variables that has the highest contribution in predicting future values of the real sector variables over and above the information contained in lagged values of output and inflation. We will label this combination of the financial factors in the forecasting regressions an index of financial conditions (FCI) and define it in terms of the notation used above as:

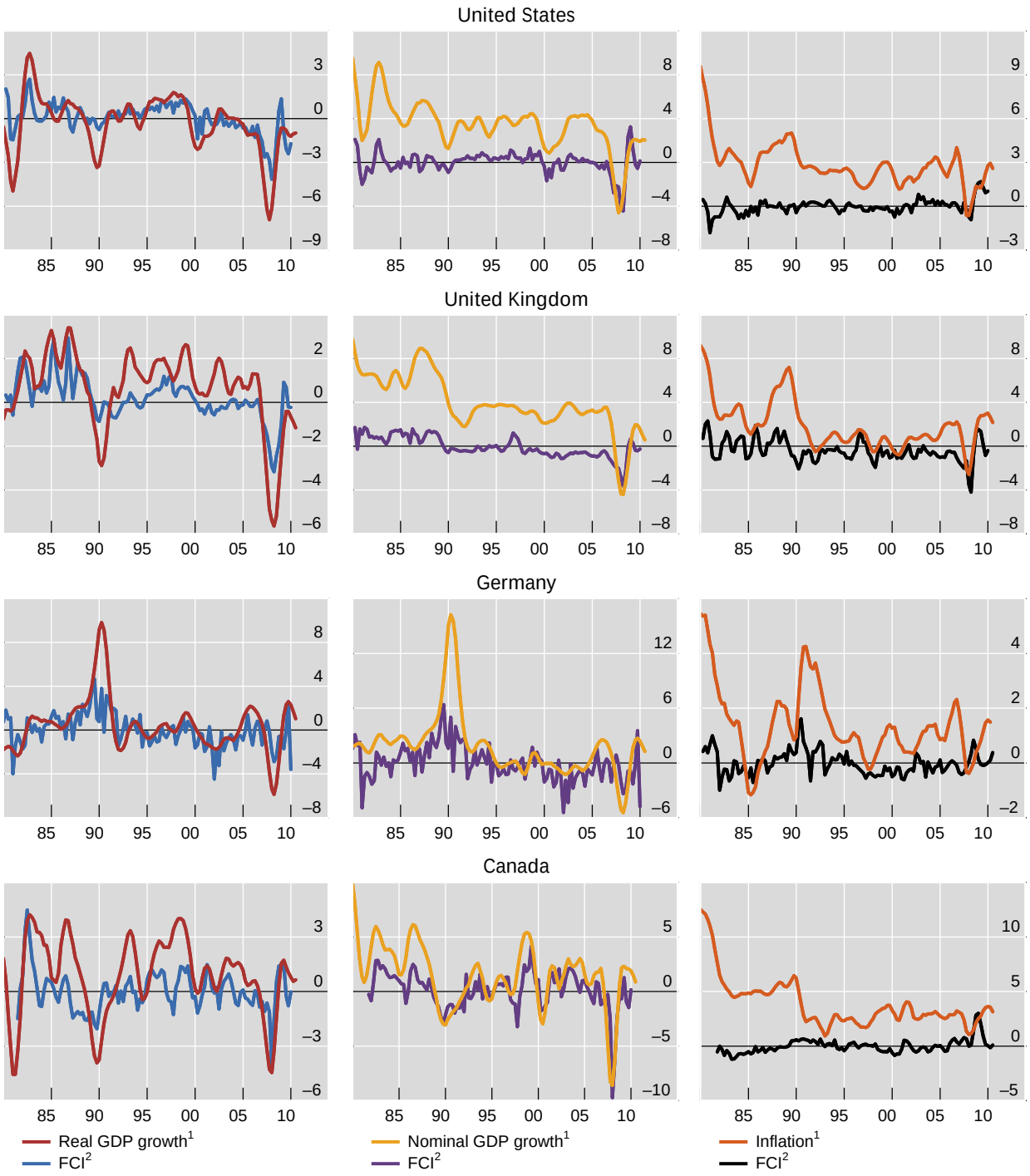
$$FCI_t = \sum_{I\in[1,\dots,4]} \sum_{i\in\{0,\dots,3\}} \gamma_{I,i} F_{I,t-i} \ ,$$

where the coefficients are those estimated in the forecasting regressions reported in Tables 2 and 3.

Two points are worth noting in interpreting the FCI. First, the FCI is a composite indicator drawing information from current and past values of all the financial variables in the dataset. Each estimated factor is constructed as a linear combination of all the variables and their lag. In addition, the selection procedure that determined the specification of the forecasting regression produced a combination of current and lagged values of some factors. Second, the interpretation of the FCI is most straightforward in the case of GDP. Positive values of the combined factors are associated with a boost to GDP growth in addition to what would have been predicted on the basis of the recent history of GDP and inflation. The converse holds for negative values of the combined factors. To the extent that greater economic activity is associated with accelerating inflation, we can also give a similar interpretation to positive values of the FCI in the inflation-forecasting equation.

Predictive ability of financial factors for real sector developments

Forecasting regression with four-quarter horizon — Graph 1

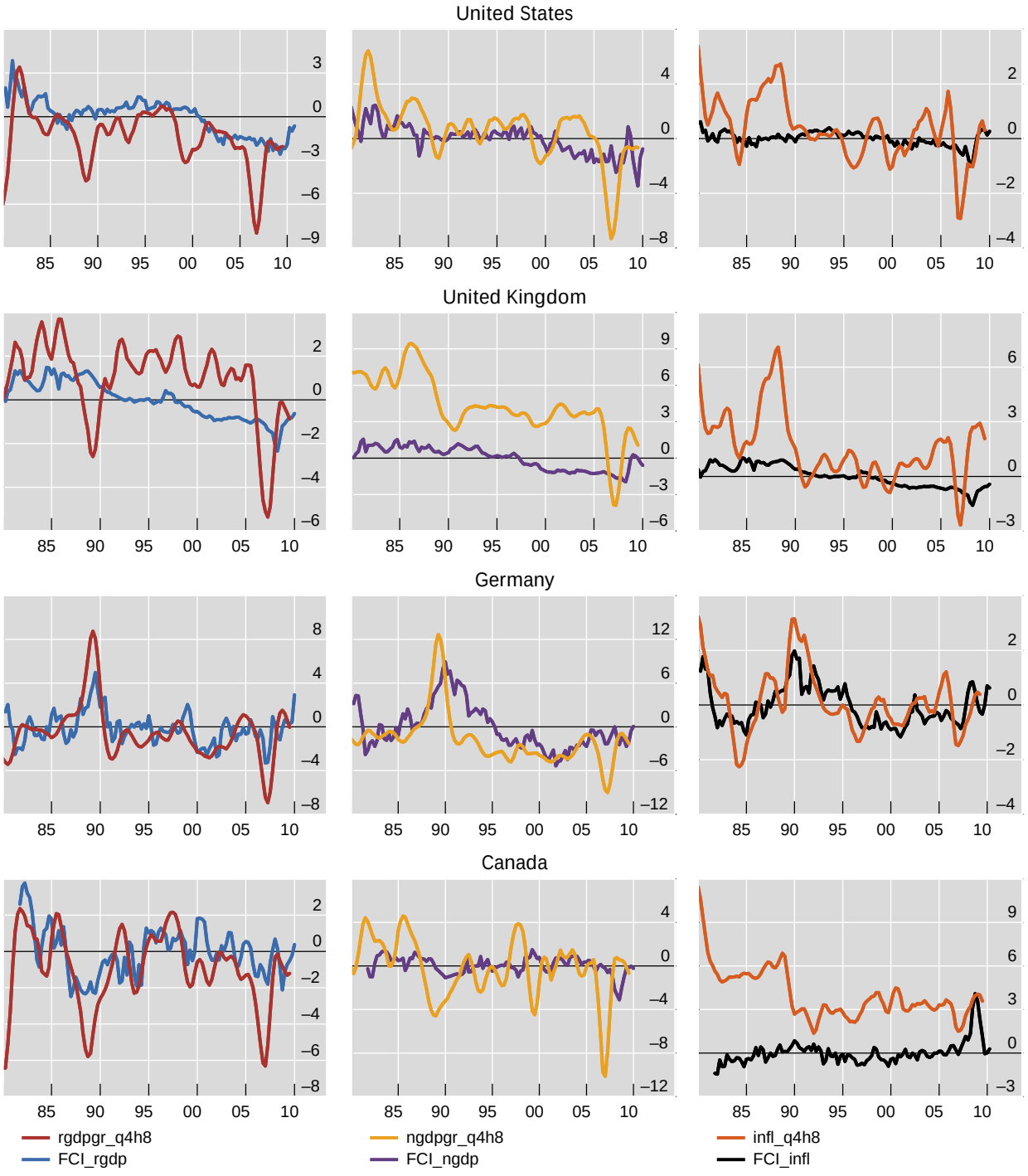


[1] Four-quarter trailing averages of annual growth; in per cent. [2] Combination of factors and their lags based on the best-fitting regressions.

Source: Authors' calculations.

Predictive ability of financial factors for real sector development

Forecasting regression with eight-quarter horizon — Graph 2



[1] Four-quarter trailing averages of annual growth; in per cent. [2] Combination of factors and their lags based on the best-fitting regressions.

Source: Authors' calculations.

Graphs 1 and 2 plot the values of the FCI estimated by each forecasting equation against the values of the variable being forecasted. The latter variable has

been lagged by four or eight quarters in order to align the dates shown for the two plotted variables. The messages are very similar to those of the forecasting regressions. The FCI does a better job in accounting for future variation in the real and nominal GDP variables than it does for that of inflation. Moreover, while the forecasting ability of the financial factors deteriorates at a longer horizon, it remains significant, especially for GDP.

Another aspect of the relationship between real and financial variables highlighted by these graphs is that financial factors tend to pick up larger swings in the macroeconomic variables. This is most clearly the case with the sharp declines in GDP during the recent crisis, but also with the business cycle turns in the early 1990s (on a four-quarter horizon basis, see Graph 1). Given that the time scale of the two lines in each graph is shifted, this means that financial factors signalled the swings one year ahead of time. This observation points to the possibility that the relationship between the financial and real variables might be non-linear, in the sense that financial factors may be most pertinent in shaping macroeconomic outcomes if they exceed their usual range of fluctuation. But this must remain a topic for future analysis as it goes beyond the scope of the linear framework we use in this article.

Conclusions

This article explored the linkages between financial and real sector variables that are revealed by purely statistical techniques. We condensed the information of a broad array of financial variables into a small set of statistical factors and used those to forecast future GDP and inflation. The results are relevant for both macroeconomists seeking to understand the links between the two sectors and for policymakers who wish to build more robust policy on the basis of this understanding.

Financial variables have significant information content for future realisations of real variables over the typical planning horizon for monetary policy. They consistently contribute to the information contained in real variables in all the countries we studied. Moreover, the information they contain tends to have a significant lag and to be more pertinent in the case of larger cyclical swings, suggesting that these variables may be able to provide earlier signals for more extreme movements in real variables. That said, the predictive ability of financial factors is stronger and more reliable for measures of economic activity than for inflation.

These messages suggest that policy frameworks aiming at macroeconomic stability can benefit from the information in financial sector variables. In forecasting exercises, financial variables can add predictive power that maintains its strength even at longer horizons. Additionally, the weaker information content of financial variables for inflation suggests that economic processes that work through the financial sector may not influence economic activity through the inflation channel. This may weaken the information content of inflation as a guide to monetary policy when economic shocks originate in the financial sector. Exploring these conjectures would require a more elaborate analytical framework that can focus directly on structural linkages between the real and financial sectors.

References

Boivin, J, M Kiley and F Mishkin (2009): "How has the monetary transmission mechanism evolved over time?", prepared for the *Handbook of Monetary Economics*.

Borio, C (2011): "Rediscovering the macroeconomic roots of financial stability policy: journey, challenges and a way forward", *BIS Working Papers*, no 354, September.

Borio, C and P Lowe (2002): "Asset prices, financial and monetary stability: exploring the nexus", *BIS Working Papers*, no 114, Basel, July.

Bordo, M, M Dueker and D Wheelock (2000): "Aggregate price shocks and financial instability: an historical analysis", *NBER Working Paper*, no 7652.

Brave, S and R Butters (2011): "Monitoring financial stability", *Economic Perspectives*, Federal Reserve Bank of Chicago, First Quarter, pp 22–43.

——— (2012): "Diagnosing the financial system: financial conditions and financial stress", *International Journal of Central Banking*, pp 191–239, June.

Christiano, L, R Motto and M Rostagno (2010): "Financial factors in economic fluctuations", *Working Paper series*, no 1192, European Central Bank.

Dudley, W, J Hatzius and E McKelvey (2005): "Financial conditions need to tighten further", *US Economic Analyst*, Goldman Sachs Economic Research, April.

English, W, K Tsatsaronis and E Zoli (2005): "Assessing the predictive power of measures of financial conditions for macroeconomic variables", *BIS Papers*, no 22, April, pp 228–52.

Estrella, A, G Hardouvelis (1991): "The term structure as a predictor of real economic activity", *Journal of Finance*, no 46, pp 555–76.

Friedman, B and K Kuttner (1992): "Money, income, prices and interest rates", *The American Economic Review*, June 1992, vol 82, pp 472–92.

Freedman, C (1994): "The use of indicators and of the monetary conditions index in Canada", in T Balino and C Cottarelli (eds), *Frameworks for monetary stability: policy issues and country experiences*, Chapter 18, pp 458–76, International Monetary Fund, Washington DC.

Gerdrup, K, R Hammersland and E Naug (2006): "Financial variables and developments in the real economy", *Economic Bulletin*, vol 77, no 3, pp 133–46.

Gertler, M and N Kiyotaki (2010): "Financial intermediation and credit policy in business cycle analysis", prepared for the *Handbook of Monetary Economics*.

Gertler, M and P Karadi (2011): "A model of unconventional monetary policy", *Journal of Monetary Economics*, vol 58, pp 17–34.

Goodhart, C and B Hofmann (2000): "Financial variables and the conduct of monetary policy", *Sveriges Riksbank Working Paper*, no 12.

Guichard, S and D Turner (2008): "Quantifying the effect of financial conditions on US activity", *OECD Economics Department Working Papers*, no 635, September.

Hatzius, J, F Mishkin, K Schoenholtz and M Watson (2010): "Financial condition indexes: a fresh look after the financial crisis", *NBER Working Paper Series*, no 16150.

Hellwig, Z (1968): "On the optimal choice of predictors", UNESCO document.

Holló, D, M Kremer and M Lo Duca (2012): "CISS – a composite indicator of systemic stress in the financial system", *ECB Working Paper*, no 1426, March.

Illing, M and Y Liu (2006): "Measuring financial stress in a developed country: an application to Canada", *Journal of Financial Stability*, vol 2 (4), pp 243–65.

Kashyap, A, J Stein and D Wilcox (1993): "Monetary policy and credit conditions: evidence from the composition of external finance", *The American Economic Review*, vol 83:1, March, pp 78–98.

Kydland, F and E Prescott. (1982): "Time to build and aggregate fluctuations", *Econometrica*, no 50 (6), pp 1345–70.

Long, J Jr and C Plosser (1983): "Real business cycles", *Journal of Political Economy*, no 91 (1), pp 39–69.

Matheson, T (2011): "Financial condition indexes for the United States and Euro Area", *IMF Working Paper*, no 11/93, April.

Mishkin, F (1991): "A multi-country study of the information in the term structure about future inflation", *Journal of International Money and Finance*, vol 10, p 2–22.

Onatski, A (2010): "Determining the number of factors from empirical distribution of eigenvalues", *The Review of Economics and Statistics*, vol 92, no 4, November, pp 1004–16.

Schwartz, G (1978): "Estimating the dimension of a model", *Annals of Statistics*, vol 6, pp 461–64.

Stock, J and M Watson (2002): "Macroeconomic forecasting using diffusion indexes", *Journal of Business and Economic Statistics*, vol 20, no 2, April, pp 147–62.

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Hedging in derivatives markets: the experience of Chile[1]

Prior to the onset of the 2008 financial crisis, domestic FX derivatives markets in Chile had gained depth and liquidity, boosted by the growing hedging needs of private pension funds. During the crisis, Chile suffered significantly less stress than other EMEs, within Latin America and outside. We present evidence suggesting that this was related to the liquidity and resilience of its FX derivatives markets.

JEL Classification: E44, F31, G23.

The collapse of Lehman Brothers in September 2008 disrupted financing to emerging market economies (EMEs), leading to a sharp drop in cross-border funding, increases in sovereign spreads and pressures in foreign exchange markets.[2] A key response of policymakers in these economies was to draw on large stocks of international reserves in order to supply foreign currency liquidity to foreign exchange markets that had ceased functioning. However, accumulating and holding official foreign reserves is costly. An important question is whether hedging in private financial markets can reduce the need for such reserves by mitigating financial stress, and intermediating foreign currency exposure within the private sector, from those agents with structurally long foreign currency positions towards those structurally short. More precisely, can large and liquid domestic derivatives markets reduce the risks associated with financial stress in sudden stop or capital flow reversal episodes?

Chile is an interesting case study. The depth and liquidity of the domestic derivatives market increased significantly in the years before the Lehman bankruptcy, driven by the growing hedging needs of the private pension funds (Administradoras de Fondos de Pensiones (AFPs) in Spanish). AFPs had relatively large investments in foreign markets but were limited in the amount of foreign currency risk they were allowed to carry. Hedging the exchange rate exposure

[1] The views expressed in this paper are those of the authors and do not necessarily represent the views of the BIS. The authors would like to thank, without implicating, Luis Ahumada, Claudio Borio, Stephen Cecchetti, Kevin Cowan, Dietrich Domanski and Christian Upper for helpful comments, which significantly improved earlier versions of the paper. We also thank Alan Villegas and Diego Urbina for skilful research assistance. All remaining errors are ours.

[2] See Jara et al (2009), Baba and Shim (2010), Moreno and Villar (2010) and Takáts (2010).

required entering into commitments to sell foreign currency in the future (ie taking a short forward position in foreign currency), to protect the Chilean peso (CLP) value of their foreign assets. In fact, AFPs typically hedged a larger share of their portfolio than was required by regulation. By the beginning of the third quarter of 2008, AFPs' net short forward position in the Chilean foreign exchange market was large enough to be the main counterpart to the net purchasing (long) forward positions taken by the two resident sectors with short FX exposures: banks and the non-financial sector.[3] We argue that, as a result of these matching needs, the size and resilience of the derivatives market was a relevant factor in explaining the fact that Chile suffered less severe stress during the global financial crisis than other EMEs with comparable or larger international reserve buffers. Resilience is explained by the continuous need of AFPs to hedge their foreign asset portfolios.[4]

The remainder of this paper is organised as follows. The next section discusses the evolution of the Chilean pension fund system and the accumulation of foreign assets by the private sector, notably pension funds. This is followed by a section reviewing the structure of Chile's derivatives markets, and then by a discussion of the empirical relationship between the size of FX derivatives markets in EMEs before the Lehman bankruptcy and the extent of financial stress in its aftermath. The last section concludes.

Pension funds and foreign asset holdings

In the early 1980s Chile substantially reformed its pension system. It moved from a defined-benefit to a privately managed defined-contribution system. Contribution to the new scheme was mandatory for all people entering the job market from May 1981 and optional for older workers. The new system had a number of important effects, including a rapid accumulation and diversification of investable resources, and the emergence of a new financial sector that by the mid-2000s had built up a large and positive net foreign asset position.[5]

Pension fund assets grew rapidly. By 1995 they were equivalent to almost 40% of GDP, and surpassed 60% by 2010. Regulations on the types of asset eligible for pension funds were liberalised over time. Initially, AFPs were only allowed to invest

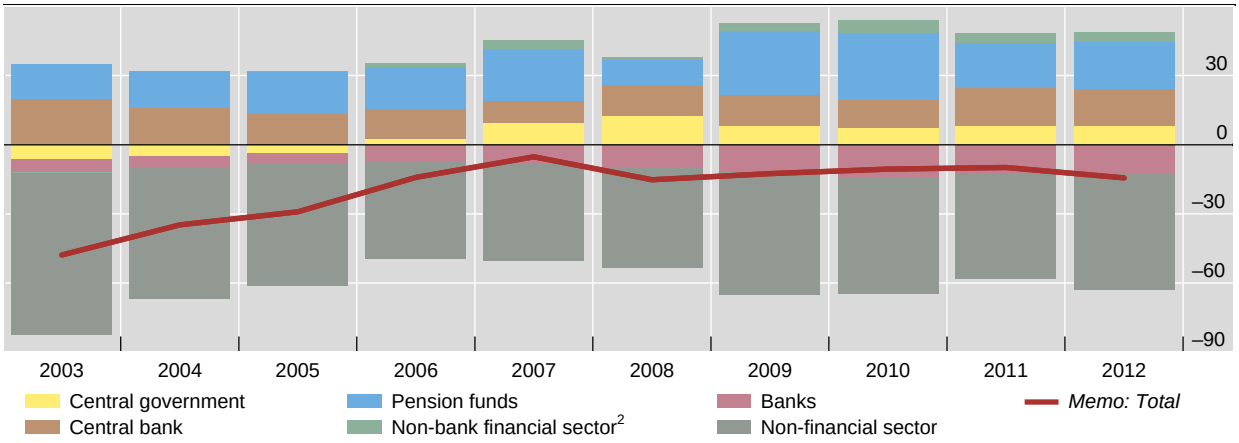
[3] While the non-financial sector hedges its position in the foreign exchange market (Acharán and Villena (2011)), banks function in part as intermediaries: they act as counterparties to pension funds and find resident or non-resident investors willing to hold the positions they have assumed. However, as discussed below, banks do not fully offset positions taken vis-à-vis pension funds.

[4] The literature provides mixed results on the effectiveness of hedging markets in EMEs. Allayannis et al (2001) present evidence that the firm value of East Asian companies that hedged their foreign currency positions before the 1997 financial crisis did not outperform non-hedgers during the crisis. In the case of Brazil, Rossi (2012) shows that the use of derivatives by Brazilian companies reduced the impact on firm value of currency depreciation, except for large fluctuations of the exchange rate. However, Coutinho et al (2012) observe that the use of derivatives reduced the cost of capital for Brazilian firms after 2008, although it tended to raise this cost before the crisis. Gómez-González et al (2012) find that hedging exchange rate risk by using derivatives had a significant positive impact on the market value of Colombian firms, after controlling for other variables like profitability, size and leverage. Taking a more macroeconomic view, Moreno (2007) argues that the low and/or ineffective hedging of foreign currency borrowing in Southeast Asia partly explains the severity of the 1997–98 crisis.

[5] For a detailed description of how the pension system evolved over time, see Hormazábal (2010).

Net international investment position by sector

End-of-period data,[1] as a percentage of GDP — Graph 1



[1] For 2012, second quarter. [2] Mutual funds and insurance companies.

Source: Central Bank of Chile.

in Chilean fixed income instruments, but new types of assets were authorised later on, including investment in the domestic stock market (starting in 1985) and in foreign assets (since 1990, with meaningful investments starting in 1993). In January 1992, only 1.5% of the (then) single fund could be invested in foreign assets, whereas by the end of 2011 that had risen to 75% for the intermediate-risk type of fund, and 100% for the most aggressive type.[6] The most conservative type could carry up to 35% of foreign assets in its total portfolio. The maximum allowed exposure to foreign currency ranged from 15 to 50% of total assets from the least to the most risky type of fund.

AFPs' foreign asset holdings began to increase steadily after the financial crises of the late 1990s. Graph 1 shows that pension funds developed a large positive net foreign asset position (mainly reflecting sizeable gross foreign assets and minuscule foreign liabilities),[7] rivalling that of the central government (which includes the sovereign wealth and the pension reserve funds) and the central bank. On the other hand, resident banks and the non-financial sector over time accumulated a significant net debtor position with the rest of the world, the latter because of substantial flows of foreign direct investment. In fact, Chile enjoys a rather exceptional situation among EMEs: it is one of the two countries among major emerging markets that have a financial (non-bank) private sector with a very large net long foreign asset position as a fraction of GDP (26% in 2007, see Table 1).[8] Having such natural resident counterparties in FX derivatives markets

[6] In 2002, a major restructuring of the system split the original single fund into five different funds, with different risk profiles. The regulators set the authorised asset pool and investment limits separately for each type of fund. Implementation of investment and exposure limits changed substantially during 2012. For the current rules, see www.spensiones.cl/portal/regulacion/582/w3-propertyvalue-5942.html.

[7] As discussed later, pension funds' hedging of their foreign asset holdings provided derivatives market hedges to domestic residents with foreign liabilities such as banks and corporations. However, such hedges are not shown in Graph 1, which reflects transactions with non-residents.

[8] The other is South Africa, which did not suffer much FX stress either, as shown below. Israel also had a financial (non-bank) private sector with a sizeable net long investment position abroad.

Net international investment position in EMEs by sector[1]

End of 2007, as a percentage of GDP — Table 1

	Monetary authorities	Government	Banks	Non-bank financial sector	Non-financial sector	Total
Argentina	17	–6	0	2	10	24
Chile	10	9	–8	26	–42	–5
Colombia	10	–7	–1	3	–30	–25
Israel	17	–7	2	10	–30	–9
Mexico	8	0	–10	1	–38	–40
South Africa	11	–1	3	24	–61	–24
Other emerging markets[2]	19	–3	–4	3	–63	–39

[1] Data for Korea, Malaysia, Peru and the Philippines are not available with same level of disaggregation. [2] Simple median of the Czech Republic, Hungary, India, Indonesia, Poland, Russia and Thailand.

Sources: Central Bank of Chile; IMF.

helped in sustaining market liquidity and resilience during periods of financial stress.

Derivatives markets and FX risk in Chile

The main market participants in the Chilean derivatives market are pension funds, non-financial firms and domestic banks (insurance companies, mutual funds and other financial firms have a very limited participation). Almost all domestic FX derivative transactions are performed in the Formal Foreign Exchange Market (Mercado Cambiario Formal in Spanish), which is an OTC market largely composed of resident Chilean commercial banks, including subsidiaries of international banks. According to Orellana and Rodriguez (2009), the main underlying assets traded in derivatives markets include foreign exchange (slightly more than 90% of notional value in 2007), commodities (around 7% of turnover in 2007) and interest rates.

FX derivative instruments consist mostly of forward contracts (over 90% of the notional amount in 2010), followed by FX swaps (7.2% in 2010). The vast majority of exchange rate forward transactions are short-term (less than 42 days). Transactions over 42 days are about 28% of the total turnover.[9] Most forward contracts are non-deliverable, which means that the obligation to purchase (long position) or sell (short position) a foreign currency (typically the US dollar) is not settled in that currency, but in Chilean pesos (CLP). Therefore, on the settlement date, if the prevailing spot exchange rate is higher than the forward exchange rate agreed to (in CLP per US dollar), the party holding the short position must pay the long position holder the difference between the spot and forward exchange rate, in CLP.

[9] These features broadly coincide with findings by Mihaljek and Packer (2010). OTC markets dominate FX hedging in EMEs, representing about 90% of their turnover. However, FX swaps have a much larger relative size in other EMEs than in Chile (about 73% of turnover in 2010). See Acharán and Villena (2011) for a detailed description of Chilean derivatives markets.

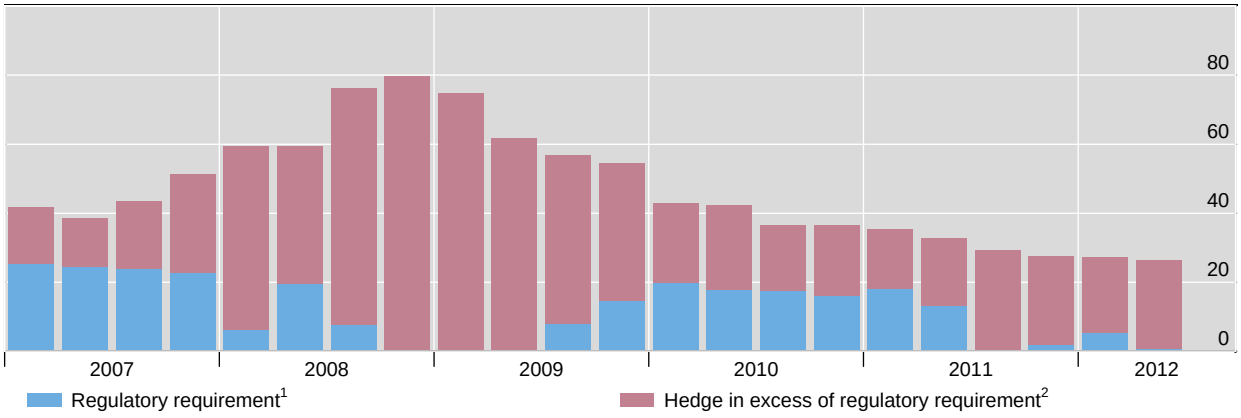
Non-deliverable forwards (NDFs) compensate long position holders when the CLP depreciates, thus shifting *exchange rate risk* to short position holders. NDFs can also help reduce FX funding risks, albeit indirectly. In particular, hedging mitigates the adverse impact of exchange rate depreciation on the financial health (and thus the borrowing capacity) of banks (and others) that have borrowed in foreign currency.

Graph 2 shows that AFPs have typically hedged a large portion of their total foreign assets. In the fourth quarter of 2008, the time of the Lehman failure, they had hedged almost 80% of their FX exposure, coverage much higher than required by regulation. Graph 3 (left-hand panel) reveals that AFPs accounted for almost the whole short side of the domestic FX derivatives markets, standing on the opposite side of most net long forward positions taken by both the banks and the non-financial sector. The net short forward position of AFPs generally exceeded the short-term foreign currency debt of banks and the non-financial sector, so AFPs could easily offer all the needed exchange rate risk coverage for those exposures (Graph 3, right-hand panel). This might partly explain why Chilean corporates seeking USD funding consistently paid a lower spread over sovereign debt than companies in most EMEs before, during and after the global crisis. For instance, since 2004 they paid on average 130 basis points less than Mexican companies, 320 basis points less than firms from emerging Asia and 80 basis points less than those from emerging Europe.

It may be noted that transactions of Chilean banks in the domestic derivatives markets were partly offset in the external market. During this period Chilean banks typically offset against non-residents about 40% of the USD net long forward position accumulated with Chile's residents, mainly AFPs.

Pension funds' FX derivatives position

End-of-period data, as a percentage of total foreign assets — Graph 2



[1] Calculated as the weighted average of the regulatory requirement for each type of fund, where funds' total assets are used as weights. The regulatory requirement was defined as an upper bound on the fraction of the total portfolio that could be exposed to FX risk. [2] Difference between the actual ratio of the net short forward position to total foreign assets and the regulatory requirement ratio (re-expressed as a fraction of total foreign assets).

Sources: Central Bank of Chile; Superintendencia de Pensiones (Chile).

Did derivatives markets reduce financial stress?

Chile's derivatives markets showed remarkable resilience during the period of stress that followed the Lehman bankruptcy in mid-September 2008.

One indicator is that the AFPs did not stop hedging, or did not extensively unwind existing positions. As discussed above, the hedging of their foreign asset portfolios increased to ratios much higher than required by regulation especially during the third and fourth quarters of 2008, and the first quarter of 2009. By continuously rolling over FX hedges they preserved the CLP value of their portfolios, and incidentally provided uninterrupted insurance to Chilean residents with short structural positions in USD. In fact, Graph 3 (right-hand panel) shows that, despite a fall in the USD value of their net short forward position (driven by the plummeting value of their foreign investments), they continued to offer ample FX coverage to insure all the short-term external debt of banks and the non-financial sector.[10]

Three explanations may be offered for the willingness of AFPs to continue providing US dollar hedging throughout the period of financial stress. First, having paid their counterparties part of the FX gains on their foreign currency assets when the CLP depreciated after the Lehman bankruptcy, AFPs had a strong financial incentive to keep hedging so as to benefit from a future recovery of the CLP. Second, the fact that they provided hedges largely via NDFs reduced FX liquidity pressures that might have arisen with standard forward or swap contracts, and that might have deterred AFPs from rolling over their positions. Third, perceptions of counterparty risk were limited in part because the authorities were in a position to deliver foreign currency if needed (see empirical analysis below). Cowan and Valdivia (2011) report that Chilean banks were not completely deprived of external financing, but the cost of borrowing increased and maturities shortened. The Central Bank of Chile provided USD swaps that helped to ease USD funding stress.

Another indicator of resilience is deviations from three-month covered interest parity (CIP), which imply that stress in Chilean FX markets was less severe than in other EMEs. In fact, the stress in FX markets in Chile at the time of Lehman bankruptcy was comparable to that observed in the euro zone, and much lower than that observed in Brazil, Korea or Mexico (Graph 4, left-hand panel).[11] CIP deviations indicate whether the implied cost of USD financing in the domestic FX forward market differs from that in international (Libor) markets.[12] Admittedly, this measure blends FX and funding risks, but the two risks are intertwined.

[10] In the very short run, the drop in the USD value of the net short forward position of AFPs may have contributed to stress in the foreign exchange market. On balance, however, the fact that they still maintained large hedges played a stabilising role.

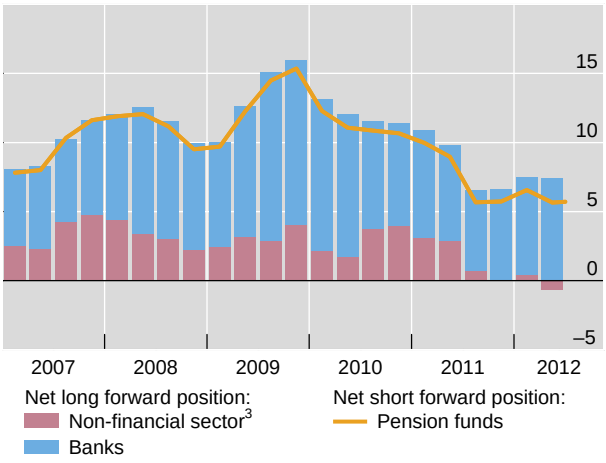
[11] In Chile, significant deviations of CIP started in the second half of 2007, coinciding with the beginning of the subprime crisis and also a rapid tightening of monetary conditions by the Central Bank. Between July 2007 and January 2008 the monetary policy rate (MPR) was increased by 125 basis points. The MPR was further tightened by 200 basis points between June and October 2008.

[12] In normal conditions, CIP is a non-arbitrage condition that requires the spread between domestic and foreign interest rates to be equal to the forward spread, ie the spread between the forward and spot exchange rates. If we denote S_t as the spot CLP/USD exchange rate in t, and $F_{t,t+s}$ as the t forward exchange rate to be settled in time t+s, then CIP means that $\frac{(1+r_{t+s}^{CLP})}{(1+r_{t+s}^{USD})} - \frac{F_{t,t+s}}{S_t} = 0$. In stress situations, this does not necessarily hold, because the difference between spreads becomes too large to trade away, usually in the face of heightened counterparty risk.

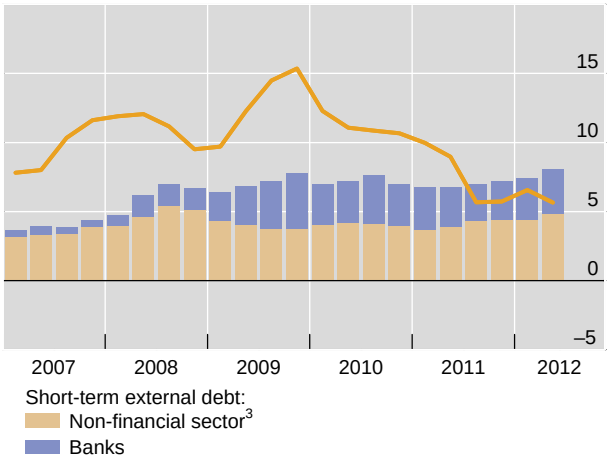
Derivatives position and short-term external debt, by institutional sector[1]

End-of-period data, as a percentage of GDP[2] Graph 3

Derivatives position



Pension funds' derivatives position and short-term external debt



[1] Derivatives positions in the Chilean FX market. [2] Four-quarter moving sum. [3] Companies and individuals.

Source: Central Bank of Chile.

Graph 4 (right-hand panel) shows that a measure of financial stress based on CIP (vertical axis) is negatively related to the ratio of international reserves to short-term external debt (horizontal axis).[13] The negative relationship is quite strong: a regression analysis reveals that almost 50% of the financial stress is explained only by the size of the foreign reserve cover to short-term external debt. Chile (which is excluded from the regression to obtain an out-of-sample prediction) is indeed an outlier: when only international reserves are considered (point labelled "CL" in the right-hand panel of Graph 4), its financial stress was much lower than that of countries with comparable foreign reserve cover. In fact, it was similar to that suffered by Malaysia and Peru, which had about three times the foreign reserve cover. The out-of-sample forecast error of CL comfortably exceeds the two standard error band of the regression.

Next, we recalculate the size of the effective hedge of the economy, adding the net short forward position of AFPs to official international reserves (point labelled "CL*" in the right-hand panel of Graph 4).[14] Both help limit foreign currency risk. International reserves do so by reducing the likelihood of a currency crisis ex ante, and by smoothing out currency depreciation ex post. FX derivatives markets allow

[13] The measure of financial stress is the percentage change of the 20-day standard deviation of CIP deviations in the domestic market between 31 August 2008 and 31 October 2008. We use this window because the 15 September 2008 Lehman bankruptcy did not immediately impact EME financial systems, but rather, the effects built up over the following month. Short-term debt is defined as the USD amount of international bank claims and debt securities that would mature within one year, as of the second quarter of 2008. The points correspond to the major EMEs that at the time were not global financial hubs and did not have an explicit currency peg in place. That is, they exclude China, Hong Kong SAR, Russia, Saudi Arabia, Singapore and Venezuela. We also exclude Thailand, which during 2008 experienced a severe political crisis, unrelated to the economic situation.

[14] Foreign reserves and hedges are not perfect substitutes, so the addition is an approximation, to make the point that both factors matter.

agents to hedge FX risk in advance, and so they might contribute to reducing stress after a financial shock, for instance by reducing the incentive to hoard foreign currency in the spot market. In addition, both can help reduce FX funding strains. They do so by reducing the vulnerability to exchange rate risk and, in the case of international reserves, by providing ammunition to tackle any FX funding strains if and when they emerge. Point CL* is no longer an outlier, and its out-of-sample forecast error almost falls inside the two standard error band.[15]

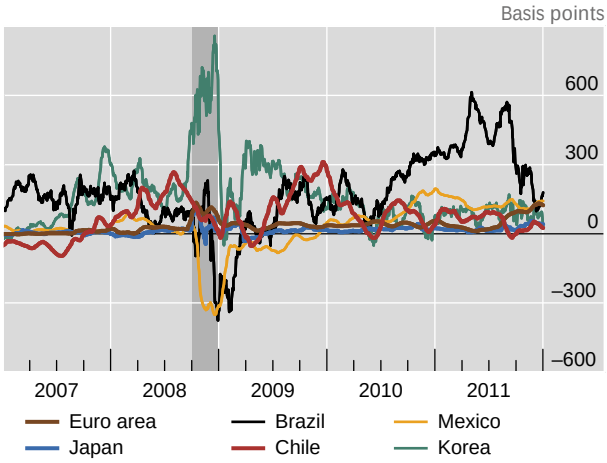
To assess robustness, using the same sample of countries (this time including Chile), we ran a regression of the same dependent variable, the change in the standard deviation of CIP deviations, on a number of controls. These included the ratio of international reserves to short-term debt (as previously defined), the ratio of FX derivatives turnover to GDP (as a measure of derivatives market size) and the ratio of FX transactions with non-residents to total FX transactions (both spot and forward), as a measure of each country's FX market integration with global markets, as suggested by Acharán and Villena (2011). The last two variables are computed using the BIS 2007 Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity.

We expect that larger international reserves will reduce financial stress, whereas more integrated markets would have suffered more from the global illiquidity that followed the Lehman event. Our hypothesis is that larger derivatives markets will

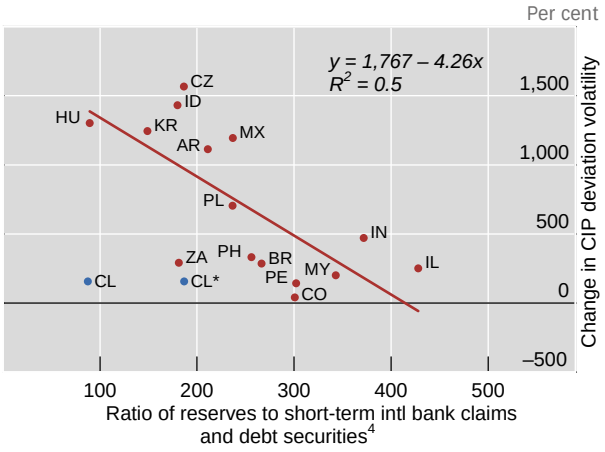
Change in CIP deviations[1] around the Lehman Brothers bankruptcy

Graph 4

CIP deviations in advanced economies and EMEs[2]



CIP deviation volatility[3] and FX risk coverage



The shaded area marks Q4 2008, when the impact of the Lehman Brothers bankruptcy was observed in emerging market economies.

AR = Argentina; BR = Brazil; CL = Chile; CO = Colombia; CZ = Czech Republic; HU = Hungary; ID = Indonesia; IL = Israel; IN = India; KR = Korea; MX = Mexico; MY = Malaysia; PE = Peru; PH = Philippines; PL = Poland; ZA = South Africa. CL* = reserves plus net short position of pension funds managers in foreign exchange domestic market.

[1] Calculated as the difference between the three-month FX swap-implied US dollar interest rate and three-month US dollar Libor. The former is derived from the CIP condition based on three-month interbank interest rates, except for: Brazil, retail certificate of deposit; Chile, DISCTB promissory note rate; Colombia, DTF rate; India and Indonesia, certificate of deposit; Japan, call money (uncollateralised). [2] 22-day moving average. [3] Change in 20-day rolling standard deviation between 31 August and 31 October 2008. [4] Q2 2008.

Sources: IMF; Bloomberg; Datastream; BIS; authors' calculations.

[15] We also tried including sovereign wealth funds (SWFs) in the analysis, but that did not qualitatively change the results, presumably because assets in SWFs are typically not very liquid, and cannot be relied upon to forestall episodes of exchange rate volatility.

Explaining CIP deviations volatility[1]

OLS regression results[2] (16 observations) Table 2

	Coefficient	t-statistic	p-value
Constant	1128.177**	2.342	0.037
Reserves / short-term intl bank claims and debt securities[3, 4]	–3.003**	–2.501	0.028
FX derivatives turnover / GDP[5]	–388.627*	–2.165	0.051
Cross border share of total FX turnover[4, 6]	15.949**	2.513	0.027
Adjusted R-squared	0.375		

** = significant at 5%; * = significant at 10%.

[1] Change in 20-day rolling standard deviation of CIP deviation between 31 August and 31 October 2008, in percentage points. See Graph 4 for CIP deviation calculation details. [2] White heteroskedasticity-consistent standard errors and covariance. [3] Q2 2008. [4] In per cent. [5] Daily average OTC foreign exchange derivatives turnover (local currency against all foreign currencies) in April 2007 as a percentage of Q2 2007 GDP (four-quarter moving sum). [6] Comprising spot and foreign exchange derivatives (outright forwards, swaps, currency swaps and options), based on daily average turnover in April 2007.

Sources: IMF; Bloomberg; Datastream; BIS; authors' calculations.

also reduce financial stress once we control for the other factors. Table 2 shows the results. The coefficients of all three variables have the expected signs, although international reserves and financial integration are more significant than the size of FX derivatives markets, whose coefficient only rejects the usual zero null hypothesis at the 10% significance level. This last result might be due to the lack of a variable to control for derivatives markets resilience, ie the ability to maintain liquidity and depth during the global crisis. Coming back to Chile, its low stress seems to be partly explained by a relatively large derivatives market and a relatively low integration with global financial markets. However, it also has the most negative residual in the sample, indicating that its low stress is poorly explained by the variables included in the regression.

Conclusions

The accumulation of foreign assets by pension funds in Chile resulted in the emergence of a financial (non-bank) private sector with a very large positive net foreign asset position as a fraction of GDP, which is unusual among EMEs. In hedging their own foreign currency exposure, pension funds became natural resident purchasers of FX short exposure, providing hedging to other residents that were financial intermediaries or were structurally short in foreign currency, such as banks and the non-financial sector. Chilean residents with structural short positions would have an incentive to purchase insurance against the possibility of exchange rate depreciation increasing their liabilities (exchange rate risk) or resulting in interruptions in financing (funding risk). The main instruments traded in the Chilean derivatives markets are NDFs, which can mitigate exchange rate and (indirectly) funding risk. This may also have contributed to the lower financing costs faced by Chilean borrowers during normal times.

The empirical evidence presented suggests that pension funds contributed to increasing the resilience of Chilean derivatives markets, notably during the period

that followed the Lehman bankruptcy. Since AFPs continued hedging a large fraction of their ample foreign asset portfolio, they offered banks and the non-financial sector FX coverage that exceeded the total short-term external debt of both sectors, and allowed banks to continue providing liquidity to derivatives markets. The fact that the central bank could provide foreign currency to ease funding stress for Chilean banks, thus reducing counterparty risk for AFPs, probably helped as well. In the end, Chilean financial markets suffered significantly less stress than those in most other emerging markets during the global crisis, especially considering the relatively small size of Chile's international reserve buffer.

The case of Chile suggests that resilient FX derivatives markets can supplement foreign reserves in dampening severe episodes of financial stress. Intuitively, these institutional and market arrangements insure two different risks: foreign currency funding risk, which central bank foreign reserves can address, and exchange rate risk, which can be addressed by FX derivatives markets that remain resilient during episodes of financial stress. In Chile, market resilience was apparently enhanced by the need of AFPs holding net foreign assets to continuously roll over their short hedging positions.

References

Acharán, M G and J M Villena (2011): "Mercado cambiario 2000–2010: comparación internacional de Chile", *Studies in Economic Statistics*, no 88, Central Bank of Chile, September.

Allayannis, G, G Brown and L Klapper (2001): "Exchange rate risk management: evidence from East Asia", *Policy Research Working Paper Series*, no 2606, The World Bank.

Baba, N and I Shim (2010): "Policy responses to dislocations in the FX swap market: the experience of Korea", *BIS Quarterly Review*, June.

Coutinho, J, H Sheng and M I Lora (2012): "The use of FX derivatives and the cost of capital: evidence of Brazilian companies", *Emerging Markets Review*, no 13, pp 411–23.

Cowan, K and C Valdivia (2011): "Issues in cross-border funding of Chilean banks", *BIS Papers*, no 57, October.

Gómez-González, J, C Rincón and K Rodríguez (2012): "Does the use of foreign currency derivatives affect firms' market value? Evidence from Colombia", *Emerging Markets Finance & Trade*, vol 48, no 4, pp 50–66.

Hormazábal, S (2010): "Multifondos en el sistema de pensiones en Chile", Documentos de Trabajo BBVA, no 10/27, October.

Jara, A, R Moreno and C Tovar (2009): "The global crisis and Latin America: financial impact and policy responses," *BIS Quarterly Review*, June.

Mihaljek, D and F Packer (2010): "Derivatives in emerging markets", *BIS Quarterly Review*, December.

Moreno, R (2007): "Experiences with current account deficits in Southeast Asia", *Central Bank of Chile Working Papers*, no 452, December.

Moreno, R and A Villar (2010): "Impact of the crisis on local money and debt markets in emerging market economies", *BIS Papers*, no 54, December.

Orellana, V and P Rodriguez (2009): "Methodology for measuring derivatives at the Central Bank of Chile", *IFC Bulletin*, no 31, July.

Rossi, J L (2012): "Understanding Brazilian companies' foreign exchange exposure", *Emerging Markets Review*, no 13, pp 352–65.

Takáts, E (2010): "Was it credit supply? Cross-border bank lending to emerging market economies during the financial crisis", *BIS Quarterly Review*, June.

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How much does the private sector really borrow? A new database for total credit to the private non-financial sector[1]

Despite their importance, data capturing total credit to the private non-financial sector are scarce. This article introduces a new BIS database that provides this information for 40 economies with, on average, more than 45 years of quarterly data, reaching back to the 1940s and 1950s in some cases. It explains the key concepts underlying the compilation of the new series, including a description of the high-level statistical criteria applied, the characteristics of the underlying series used and the statistical techniques employed. For illustration purposes, some facets of the historical evolution of total credit are explored, revealing interesting similarities and differences across countries.

JEL classification: C82, E51.

Credit is vital for economic activity. Households borrow to smooth consumption and purchase homes. Firms often require credit to finance investments. Unsurprisingly, private sector borrowing has important implications for policy. It influences the monetary transmission mechanism and is a major determinant of financial stability – history shows that systemic banking crises tend to be preceded by unusually large build-ups of credit in the private sector.

Despite this importance, series for *total credit* to the non-financial private sector have not been readily available. Even in countries that compile financial accounts, the series for total credit tend to be quite short. As a result, practitioners and researchers have often resorted to well established statistics on bank credit that fail to include credit from non-banks or foreign lenders.

To remedy this, BIS statisticians have compiled long-run series of total credit for 40 advanced and emerging market economies. In doing so, they consulted national

[1] The construction of the long-run credit series would have been impossible without the extensive help of Otakar Cejnar, Irni Ibrahim, Paschalina Karampasi, Denis Marionnet, Rodrigo Oliveira and Robert Szemere. Hubert Bunner provided excellent technical assistance. We are also grateful for the cooperation of national central banks. The break-adjusted series are BIS estimations. Despite every reasonable effort to ensure that the long series on credit are accurate, no guarantees can be made. This article benefited from useful comments by Stefan Avdjiev, Claudio Borio, Steve Cecchetti, Boris Hofmann, Bob McCauley, Christian Upper, Paul Van den Bergh and Phillip Wooldridge, and research assistance by Angelika Donaubauer and Marjorie Santos Beslmeisl. The views expressed are those of the authors and do not necessarily reflect those of the BIS.

central banks to ensure the best possible coverage. A new database on the BIS website makes this information public.[2] For each country and whenever possible, the database contains total credit to the non-financial private sector and its two subcomponents – the household and non-financial corporate sectors – as well as bank credit to the non-financial sector. The database will be updated quarterly.

The new total credit series have important advantages relative to previously available credit series. The new data cover much longer periods and many more countries than nearly all existing total credit series. On average, 45 years of quarterly data are available. For several countries, including Argentina, Germany, Italy and the United States, data start as early as the late 1940s/early 1950s. Importantly, the new series account for *credit from all sources*, not only that extended by domestic banks. International comparability and consistency across time are also quite high, as uniform statistical criteria have been applied as much as possible. That said, some approximations had to be made to overcome gaps in the historical series or changing compilation practices. All these details and exceptions are noted in the metadata published with the series on the BIS website.

For illustration purposes, this article also explores some facets of the historical evolution of total credit. While total credit has generally risen substantially relative to GDP, levels and trends in private sector borrowing have varied across countries to a surprising degree. For instance, in several economies, total credit-to-GDP ratios already significantly exceeded 100% in the 1960s and 1970s. Equally, in a number of countries, the share of domestic bank credit in total credit has actually increased substantially over the last 40 years – that is, banks have become more, not less, important. And finally, sectoral breakdowns show that there has been a general shift towards more household credit. In some countries, households now borrow even more than corporates.

This special feature is structured as follows. It first discusses the compilation of the new total credit series, describing the high-level statistical criteria applied, the characteristics of the underlying series used and the statistical techniques employed. The article also identifies some of the problems faced by compilers and examines how they were addressed. Finally, the historical developments of total credit are analysed.

Characteristics of the new series for total credit

Credit series are defined by several characteristics (Table 1), most importantly the borrower, the lender and the financial instrument(s). The new data focus on borrowing from non-financial corporations, households and non-profit institutions serving households. The aggregate of these sectors is referred to as the "non-financial private sector". Separate series for the corporate and household sectors (including non-profit institutions serving households) are also available.

In terms of lenders, the new total credit series aim to capture *all sources* independent of the country of origin or type of lender. This goes well beyond the provision of credit by domestic depository corporations, such as commercial banks,

[2] www.bis.org/statistics/credtopriv.htm.

Characteristics of credit data[1]

Table 1

	Total credit	Domestic bank credit	Cross-border bank credit
Source	Financial accounts	Monetary surveys	BIS international banking statistics
Borrowers			
Non-financial corporations			
Private non-financial corporations	✓	✓	✓
Public non-financial corporations	✓	✓	✓
Households	✓	✓	✓
Non-profit institutions serving households	✓	✓	✓
Other financial corporations	–	–	✓
Lenders			
Non-financial corporations	✓	–	–
Financial corporations	✓	–	–
Central banks	✓	–	–
Other domestic depository corporations	✓	✓	–
Other financial institutions	✓	–	–
General government	✓	–	–
Households	✓	–	–
Non-profit institutions serving households	✓	–	–
Rest of the world			
Internationally active banks	✓	–	✓
Other sectors	✓	–	–
Instruments			
Debt securities[2]	✓	✓	✓
Loans	✓	✓[3]	✓
Equities and investment fund shares	–	–	–
Insurance, pension and standardised guarantee schemes	–	–	–
Financial derivatives and employee stock options	–	–	–
Trade credit and advances	–	–	–
Other accounts receivable/payable	–	–	–
Currency[4]	National currency	National currency	National currency
Valuation method			
Loans	Nominal value	Nominal value	Nominal value
Debt securities[2]	Market value	Market value[5]	Market value[5]
Intra-sector consolidation	Not consolidated	No intra-sector transactions[6]	No intra-sector transactions[6]

[1] Credit provided by other financial institutions follows the same classification as domestic bank credit, except for the lender coverage. [2] Debt securities include bonds and short-term paper. [3] Not adjusted for securitisation. [4] Exchange rate movements can affect reported levels of credit as loans, particularly cross-border ones, can be denominated in multiple currencies. [5] International statistical manuals recommend valuing debt securities at market values, but this is rarely implemented. [6] Consolidation is not an issue as there are no intra-sector transactions. Only lending relationships between the banking and the private non-financial sector are captured.

Source: Authors' calculations.

savings banks or credit unions, covered by traditional domestic bank credit series, to include eg securitised credits held by the non-bank financial sector or cross-border lending. The coverage of financial instruments includes loans and debt securities such as bonds or securitised loans.

To ensure that the new long-run total credit series exhibit these desired characteristics and that they are as internationally comparable as possible, compilers had to overcome two challenges. First, suitable current as well as discontinued credit series had to be identified. Second, these series needed to be linked in a consistent fashion, adjusting for breaks if the borrower, lender or instrument coverage changed.

The remainder of this feature discusses each of these steps in turn, concentrating for the first one on the three main types of credit series used (country-specific information on exact data sources is available in the metadata).

Step 1: Underlying credit series

As they are fully in line with the desired borrower, lender and instrument coverage (Table 1), the sectoral financial accounts that contain the balance sheets of non-financial corporations, households and non-profit institutions serving households are the natural starting point for constructing the total credit series. The financial accounts form part of the UN System of National Accounts (SNA) and are also sometimes known as the flow of funds. In the United States and Italy, this covers the entire time span for which credit data are available after World War II. But in most cases, these statistics start only in the 1990s or later. Some countries have not yet begun to compile financial accounts.

When no financial accounts are available, total credit to the private non-financial sector is estimated based on two components. First, domestic bank credit stands in for total domestic credit. In two cases, it is also possible to add credit provided by other financial institutions. Second, total cross-border credit is approximated by cross-border bank credit taken from the BIS international banking statistics.

Total credit from financial accounts

For countries that do compile financial accounts, total credit to the private non-financial sector is estimated based on the sum of the stock of loans from all series, domestic and foreign, to non-financial corporations, households and non-profit institutions serving households, plus the debt securities issued by non-financial corporations. These components also allow for the construction of separate series for the non-financial corporate sector and the household sector (including non-profit institutions serving households).

In some countries, a historical set of financial accounts for earlier periods complements the set of financial accounts compiled under current statistical standards.[3] It is then possible to extend the total credit series back in time, making

[3] Current financial accounts are compiled under SNA93 standards (or the corresponding European version, ESA 95) with the exception of Australia, which follows SNA08 standards. Historical financial accounts following SNA68 standards (or ESA 79) and sometimes even SNA53 are available for

adjustments for differences in the borrower, lender or instrument coverage if necessary (see below).[4]

In many countries, financial accounts were originally compiled at an annual frequency. In this case, quarterly data are estimated by applying the widely used Chow-Lin method (Chow and Lin (1971)), which extrapolates a linear regression of the annual series on related quarterly series – in this case, usually domestic bank credit – subject to a constraint that the estimated quarterly series add up to the observed annual one.

As total credit captures lending from all sources, it also captures lending relationships within the same (private non-financial) sector, most importantly within the corporate sector. Consolidating, ie netting out credits between institutional units of the same sector, thus lowers the measured level of total credit. The new total credit series are not consolidated, because for most purposes, such as assessing debt sustainability, it is not relevant whether the source of credit is eg a bank or another corporate.

Consolidation may, however, be appropriate when it comes to lending relationships within the same conglomerate – such as between a parent company and its subsidiaries – as the same decision unit is involved and these credits are often only extended to minimise taxes. Available evidence suggests that these types of loans can be meaningful in some European countries such as Belgium, Ireland or Sweden (Bloomberg et al (2012), Cusse et al (2013)). However, removing loans within the same conglomerate from the new total credit series was impossible as data are not available to delineate them precisely. This approach is also in line with the European Commission's "Scoreboard for the surveillance of macroeconomic imbalances (European Commission (2012)).

Even though the new series are not consolidated, trade credit (as well as other accounts payable and receivable) is excluded from the new total credit series because the quality of the underlying data is globally poor. This can be easily achieved because these credits are identified as separate financial instruments in the financial accounts (Table 1) – if they are recorded at all, as their historical and country coverage is limited.

Domestic credit

If no financial accounts are available, the domestic component of total credit to the non-financial sector is based on domestic bank credit. For Australia and Russia, it is also possible to add credit to the private sector granted by other financial institutions (such as insurance companies or mortgage providers).[5]

The main source for bank credit series is the sectoral balance sheets of depository corporations that form the basis for the compilation of the monetary

Germany, Japan, Korea, Norway, Sweden and the United Kingdom. The historical set of Finnish financial accounts follows a national methodology.

[4] No information on stocks from financial accounts exists in Denmark between 1994 and 1997. But flow data are available from the financial accounts, from which levels are derived.

[5] These data are available for other countries as well, but only for periods when total credit series from the financial accounts are used for the new total credit series.

aggregates and their counterparts.[6] The counterparts cover bank claims on the private non-financial sector (see Table 1). For two countries (Ireland and India), the counterparts are not available for the initial periods when the collection of monetary aggregates first began. In these cases and after adjusting for breaks (see below), bank credit is approximated by the broad monetary aggregate M3.[7]

One problem with bank credit series is that they are affected by securitisation. Under traditional accounting rules, derecognised securitised loans do not sit on banks' balance sheets. Therefore, they are not reported in the monetary statistics, even though banks have often supported their securitised loan portfolios with off-balance sheet commitments, as the crisis has clearly shown.[8] But this is changing. Under the International Financial Reporting Standards (IFRS), traditional securitisations are not considered off-balance sheet anymore. Note, however, that securitisation operations do not affect the total credit series when sourced from the financial accounts as these cover credit from *all* sectors, including special purpose vehicles to which banks sold portfolios of loans.

Cross-border credit

When the new total credit series are not taken from the financial accounts, the cross-border component of total credit is based on the BIS international banking statistics (IBS).[9] These statistics capture credit extended by banks located abroad. But they leave out credit from foreign non-bank lenders and are often not available for the whole sample period covered by bank credit.

The volume of cross-border bank credit to the private non-financial sector is derived from both the locational and the consolidated IBS.[10] The locational by residence statistics comply with statistical standards used in financial accounts. The IBS allocate creditors and debtors geographically according to their residence, and permit loans and debt securities to be identified separately among the total claims. However, the locational statistics currently only allow for a breakdown of banks' claims between banks and non-banks. The share of the private non-financial sector in the latter category is taken from the consolidated IBS.[11] Whilst these statistics

[6] More precisely, the sectoral balance sheets of "other depository corporations" (which exclude the central bank) are used. If these are not available, the balance sheets of the banking sector or national surveys on depository corporations are used as an alternative. Bank credit series are taken from the IMF International Financial Statistics for China for 1985–92, Malaysia for 1964–73 and Thailand for 1957–75.

[7] M3 covers mainly deposit liabilities of banks or depository corporations, and its evolution is highly correlated with developments in the credit aggregates in the years when the two can be compared, especially during the early periods.

[8] In most countries, no data are available to historically track the amounts of derecognised loans. An exception is Belgium, where in 2012 depository corporations' derecognised loans represented 40% of the loans booked on banks' balance sheets.

[9] External debt statistics collected under the international investment position framework could provide coverage of cross-border credit from all sources for some countries. However, these data are not used because doing so would hamper cross-country comparability, as very few countries compile these series with sufficiently detailed instrument and borrowing sector breakdowns for the periods when no financial accounts are available.

[10] For a general introduction to the IBS, see McGuire and Wooldridge (2005) or the introduction to the statistical annex of this *BIS Quarterly Review*. For recent enhancements, see CGFS (2012).

[11] By doing so, cross-border credit to the non-financial sector is overestimated because the non-bank private sector includes non-bank financial corporations (see Table 1). Furthermore, it is implicitly

offer a more granular borrower breakdown than the locational IBS, they are compiled under a different framework that consolidates banks' claims according to the location of their headquarters and looks through transactions with banks' related entities to identify the final borrower.

Step 2: Constructing long series for total credit

Total credit from financial accounts, domestic bank credit and cross-border bank credit are the three main building blocks underlying the construction of the new total credit series. Table 2 shows which components are used when for all the economies covered, and highlights the starting points for all the credit series available in the database (bold entries).

Combining a range of different series gives rise to challenges. In particular, valuation practices may not always be fully consistent. And the borrower, lender or instrument coverage can change, leading to breaks in the series. In this section, we discuss these challenges and explain the technique used to adjust for breaks. A concrete example is given in the box.

Asset valuations and exchange rate effects

Even though international statistical manuals such as the IMF Monetary and Financial Statistics Manual (IMF (2000)) and the UN System of National Accounts 2008 (European Communities et al (2009)) provide harmonised standards for asset

Combining different series and adjusting for breaks: an example

To compile the long-run credit series for Ireland, four credit series are used:

- Broad monetary aggregate (M3) from Q2 1971 to Q2 1992
- Domestic bank credit from Q3 1992 to Q1 1999
- Domestic bank credit and cross-border bank credit from Q2 1999 to Q4 2001
- Total credit from the financial accounts from Q1 2002

Each transition implies breaks in the lender coverage leading to shifts in the level of total credit. In particular, at the end of Q3 1992, domestic bank credit was 52% higher than M3. At the end of Q2 1999, adding cross-border bank credit increases the level of total credit by 42%. And at the end of Q1 2002, the total credit from the financial accounts exceeded the sum of domestic and cross-border bank credit by 10%.

Break-adjusted credit series were obtained by taking total credit as reported in the financial accounts and scaling up (ie multiplying) the sum of domestic and cross-border bank credit by a factor of 1.10 between Q2 1999 and Q4 2001, bank credit by a factor of 1.56 (= 1.10 * 1.42) between Q3 1992 to Q1 1999 and M3 by a factor of 2.37 (= 1.10 * 1.42 * 1.52) before Q3 1992.①

① Table 3 reports the average differences between break-adjusted (*BA*) and unadjusted (*UA*) total credit relative to the adjusted series. These numbers reflect the adjustment factors (*af*) and break dates. For instance, for 1970–90 in Ireland, the table shows that (*BA* – *UA*) / *BA* was on average 58%, which is equal to $1 - UA / BA = 1 - (af_{1971–92})^{-1} = 1 - 1 / 2.37$.

assumed that the sectoral breakdown is not affected by differences in the reporting populations and definitions in the locational and consolidated statistics, or the consolidation of claims on related entities.

Starting dates for the new credit series (in bold) and sources

Table 2

Benchmark series / Sources	Domestic bank credit	Total credit					Credit to non-financial corporations and credit to households
		Domestic bank credit	Bank credit (domestic + cross-border)	Bank credit (domestic + cross-border) + dom credit from other financial institutions	Total credit (annual financial accounts)	Total credit (quarterly financial accounts)	
Argentina	From **1940**	**1940**–89	From 1990[1]				
Australia	From **1953**	**1953**–77		1977–88[2]		From 1988	From **1977**
Austria	From **1949**	**1949**–95			1995–2000	From 2000	From **1995**
Belgium	From **1970**	**1970**–80				From 1980	From **1980**
Brazil	From **1993**	**1993**–94	From 1995[1]				
Canada	From **1954**	**1954**–68				From 1969	From **1969**
China	From **1985**		From **1985**[3]				From **2006**
Czech Republic	From **1993**	**1993**–95			1995–2003	From 2004	From **1995**
Denmark	From **1951**	**1951**–94				From 1994	From **1994**
Euro area	From **1997**					From **1999**	From **1999**
Finland	From **1974**				**1970**–97	From 1997	From **1970**
France	From **1969**	**1969**–77				From 1977	From **1977**
Germany	From **1948**	**1948**–70			1970–90	From 1991	From **1970**
Greece	From **1960**	**1960**–85	1985–94		1994–97	From 1998	From **1994**
Hong Kong SAR	From **1978**	**1978**–99	From 1999				From **1990**
Hungary	From **1989**					From **1989**	From **1989**
India	From **1951**	**1951**–85[4]	From 1985				From **2007**
Indonesia	From **1976**	**1976**–85	From 1985				From **2001**
Ireland	From **1971**	**1971**–99[5]	1999–2001			From 2002	From **2002**
Italy	From **1974**				**1950**–94	From 1995	From **1950**
Japan	From **1963**					From **1964**	From **1964**
Korea	From **1960**				**1962**–74	From 1975	From **1962**
Luxembourg	From **2003**					From **2003**	From **2005**
Malaysia	From **1964**	**1964**–85[6]	From 1985				
Mexico	From **1980**	**1980**–93	1993–94[1]			From 1994	From **1994**
Netherlands	From **1961**	**1961**–90			1990–2004	From 2005	From **1990**
Norway	From **1953**	**1953**–74				From 1975	From **1975**
Poland	From **1992**	**1992**–95			1995–2003	From 2003	From **1995**
Portugal	From **1947**	**1947**–85	1985–95		1995–97	From 1997	From **1979**
Russia	From **1995**		**1995**–2005	From 2005			
Saudi Arabia	From **1993**		From **1993**				
Singapore	From **1991**		From **1991**				From **1991**

[1] International banking statistics data are available before these dates but were not used due to excessive exchange rate effects in the wake of currency crises. [2] Comprises only credit extended by domestic banks and non-bank financial institutions. [3] IMF data for Q4 1985–Q4 1992. [4] For Q2 1951–Q1 1970, total credit is estimated by monetary aggregate M3. [5] For Q2 1971–Q2 1992, total credit is estimated by monetary aggregate M3. [6] IMF data for Q2 1964–Q3 1973.

Sources: National data; authors' calculations.

Starting dates for the new credit series (in bold) and sources (cont) Table 2

Benchmark series / Sources	Domestic bank credit	Total credit					Credit to non-financial corporations and credit to households
		Domestic bank credit	Bank credit (domestic + cross-border)	Bank credit (domestic + cross-border) + dom credit from other financial institutions	Total credit (annual financial accounts)	Total credit (quarterly financial accounts)	
Spain	From **1970**	**1970**–80			1980-1989	From 1989	From **1980**
Sweden	From **1961**	**1961**–80			1980-1995	From 1996	From **1981**
Switzerland	From **1975**	**1975**–99			From 1999		From **1999**
Thailand	From **1957**	**1957**–85[7]	From 1985				From **1991**
Turkey	From **1986**		From **1986**				From **1986**
United Kingdom	From **1963**					From **1962**	From **1976**
United States	From **1952**					From **1952**	From **1952**

[7] IMF data for Q1 1957–Q3 1975.

Sources: National data; authors' calculations.

valuations, those standards may not always be fully implemented. In principle, nominal values are used for loans, corresponding to the origination price (historical cost) plus the interest that has accrued but not been paid if there has not been a default. And in line with accounting practices, written-off loans are excluded from the reported outstanding loans. All other financial assets, including debt securities, are in principle valued at market prices (Table 1). In practice, though, debt securities are often reported at nominal value. This may affect international comparability in cases of large volumes of debt securities and large price swings, but is impossible to adjust for.

The new credit series are reported in national currencies. Exchange rate movements can thus affect the reported levels of total credit as cross-border and, to a lesser extent, domestic loans are often denominated in multiple currencies. These effects can be dramatic, particularly during a crisis. For example, due to the massive devaluation and a large share of foreign currency credits, total credit in Indonesia expressed in rupiahs doubled within two quarters of the Asian financial crisis. Data adjusted for exchange rate fluctuations may therefore tell very different stories from those implied by the unadjusted series (Avdjiev et al (2012)). Which data provide the appropriate insights ultimately depends on the question asked. Exchange rate adjustments may be useful when assessing short-term growth, whereas unadjusted credit may be better for gauging financial sustainability. As a rule, the new total credit series are not adjusted for exchange rate movements. This correction is only possible for the international banking statistics where a currency breakdown is available, but would be highly artificial for the long-run series.

Changes in borrower, lender or instrument coverage

Ideally, the constructed long-run credit series would be fully consistent with the general criteria outlined in Table 1 regarding the borrower, lender or instrument coverage. However, this is not the case, leading to breaks which must be taken into account. All breaks are reported in the metadata and, to ensure transparency and

help users to make their own adjustments, both break-adjusted and unadjusted credit series are available on the BIS website. This applies to the total credit series, the two sectoral and the bank credit series.

Even though the sum of domestic and cross-border bank credit provides a very good approximation of total credit, it does not capture all sources of credit. Clearly, the main credit providers are reflected, but total credit series from the financial accounts capture a broader universe that includes eg domestic and cross-border lending by non-banks. This gives rise to breaks, when coverage moves from the sum of both components to total credit from the financial accounts. Equally, a break occurs when the cross-border credit is added to the domestic bank credit. Bank credit series themselves may also exhibit changes in the coverage of lenders, especially for earlier periods. For example, lending by the central bank may sometimes be included.

In principle, there should be no major inconsistencies for the borrower and instrument coverage across the three different credit series used. However, compilation practices have changed over time. On the borrower side, for example, it is not always possible to exclude lending to other financial corporations such as insurance companies or securities dealers. And on the instrument side, trade credit and holdings of shares by depository corporations cannot always be fully removed from some national data.

Adjusting for breaks

When breaks occur, all earlier observations are proportionally scaled up or down.[12] For example, to adjust for a break at time Z owing to the transition from domestic and international banking credit (b_t) to total credit from the financial accounts (f_t), break-adjusted series are derived as follows:

$$Total\ credit(break\ adjusted)_t = \begin{cases} f_t & if\ t \geq Z \\ b_t * \dfrac{f_Z}{b_Z} & if\ t < Z \end{cases}$$

In general, both break-adjusted and unadjusted series are imperfect measures. The former assume that sources of credit that are not recorded behave in a similar fashion to observable series, whilst the latter does not account for unobserved components at all, even though they may be quite important. Table 3 shows the average difference between break-adjusted and unadjusted total credit relative to the adjusted series for a range of countries. Differences can be large, particularly in earlier periods, often reflecting the impact of several breaks. The average difference was 27% before 1970, and has decreased to approximately 0% now. Similarly, the number of countries for which break adjustments do not play a role has increased from two to 37 since 2005.

[12] In a few cases, break adjustments can affect the sectoral analysis somewhat. For unadjusted series, the total credit series always equal the sum of the series for the household and non-financial corporate sectors. However, for early periods in six countries, the break adjustment implies that the sum of break-adjusted credit series for the household and corporate sectors no longer adds up to the break-adjusted total credit series exactly. This is because pre- and post-break values for overlapping periods determine adjustment factors in such a way that the adding-up constraint only holds in the overlapping period. Despite this, it is best to use the break-adjusted series for economic analyses.

Average difference between break-adjusted and unadjusted total credit

As a percentage of the break-adjusted series Table 3

	Before 1970	1970–90	1990–2005	After 2005
Austria	14	19	15	1
Canada	65	0	0	0
Germany	37	1.2	0	0
Ireland		58	27	0
Japan	8	9	5	0
Korea[1]	41	–16	2	0
Mexico		33	9	0
Portugal	62	59	22	0
Thailand	22	27	8	0
United States	0	0	0	0
Average across all countries	27	17	4	0
No of countries without breaks	2	5	15	37
No of countries with data	19	32	40	40

[1] The negative value for Korea in 1970–90 is due to a change in the compilation practices of financial accounts from SNA73 to SNA93 standards, where the earlier period captures a much broader universe of instruments.

Sources: National data; authors' calculations.

Comparability

Despite the caveats discussed above, the new total credit series are fairly comparable across countries, particularly in the last 10–20 years when they are mainly based on data from financial accounts (Table 2). As just discussed, uncertainties are somewhat larger in periods before that as total credit is often approximated by domestic and international bank credit. For 27 of the 40 economies covered by the database, the most recent observations are sourced from financial accounts, which are globally compiled in accordance with the same methodological standards (European Communities et al (2008)). There, comparability is solid, even if national deviations might sometimes occur. Given international recommendations (IMF and FSB (2009)), more and more countries will compile financial accounts in the future, which will then be used in the total credit series to further enhance cross-country comparability.

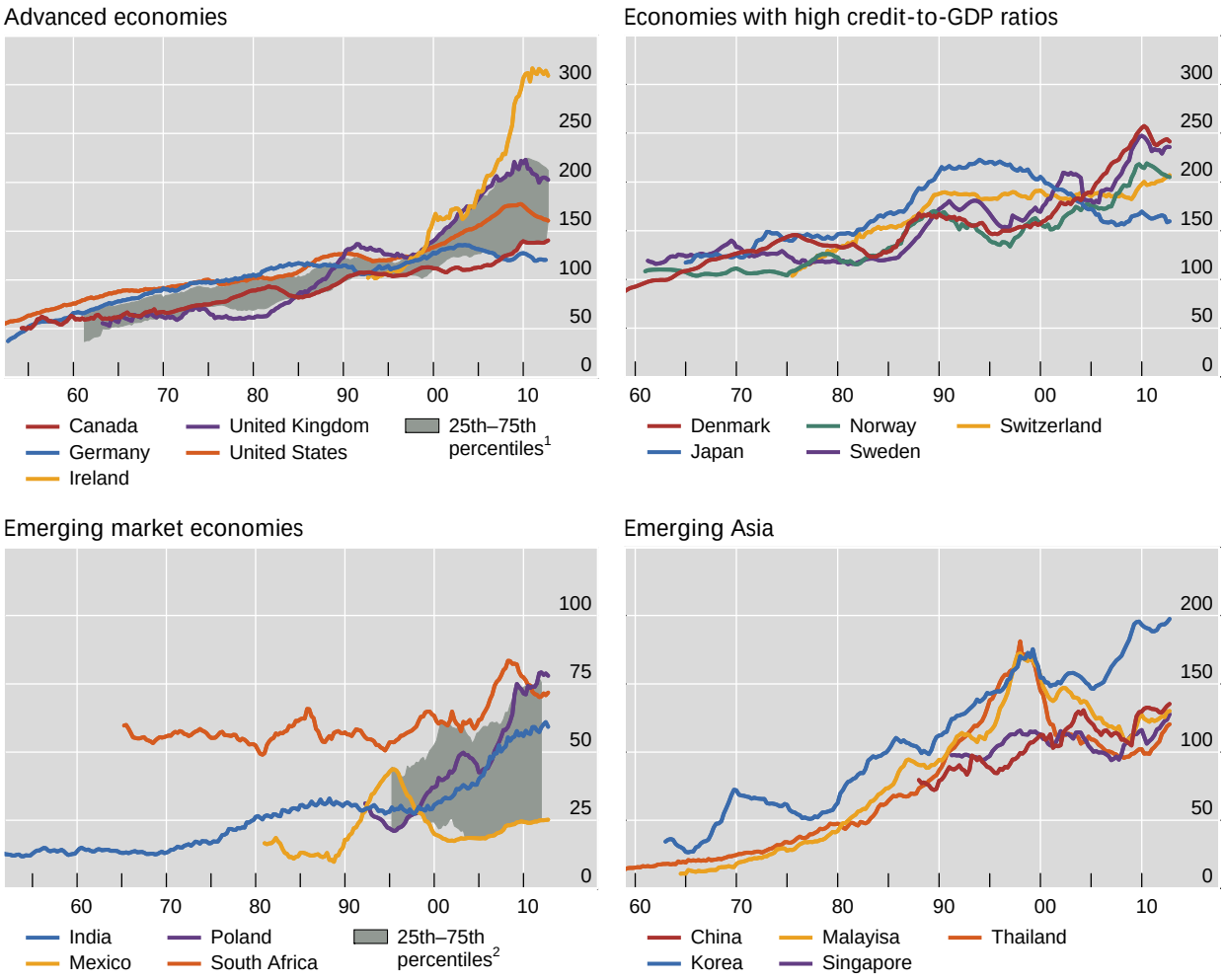
Long-run credit: some historical developments

Over the last 60 years, credit has substantially outgrown GDP in nearly all countries in the sample. That said, surprising differences are evident from Graph 1, which groups countries with similar experiences. The data indicate that the volume of total credit was around 50% of GDP in the 1950s in many advanced economies (top left-hand panel). It then grew at a steady pace for the next 20 to 30 years. By the late 1980s, credit booms emerged in some countries, such as the United States and the

United Kingdom. But cross-country developments started to diverge much more at the end of the 1990s (as highlighted by the shaded area showing the 25th to 75th percentiles of the cross-country distribution). For some countries, like Germany and Canada, total credit growth was modest (their credit-to-GPD ratios are now 120% and 140%, respectively). Other countries experienced rapid credit expansions, with credit-to-GDP ratios reaching levels close to or above 200% around the global financial crisis. Ireland is the extreme case: in 1995, it had a credit-to-GDP ratio of around 100%. Fifteen years later, this figure peaked at 317%, and it has not dropped much since.[13]

Total credit as a percentage of GDP

Graph 1



[1] Of the countries listed plus Australia, Austria, Belgium, Finland, France, Greece, Italy, the Netherlands and Spain. [2] Of the countries listed plus Brazil, the Czech Republic, Hungary, Russia, Saudi Arabia and Turkey.

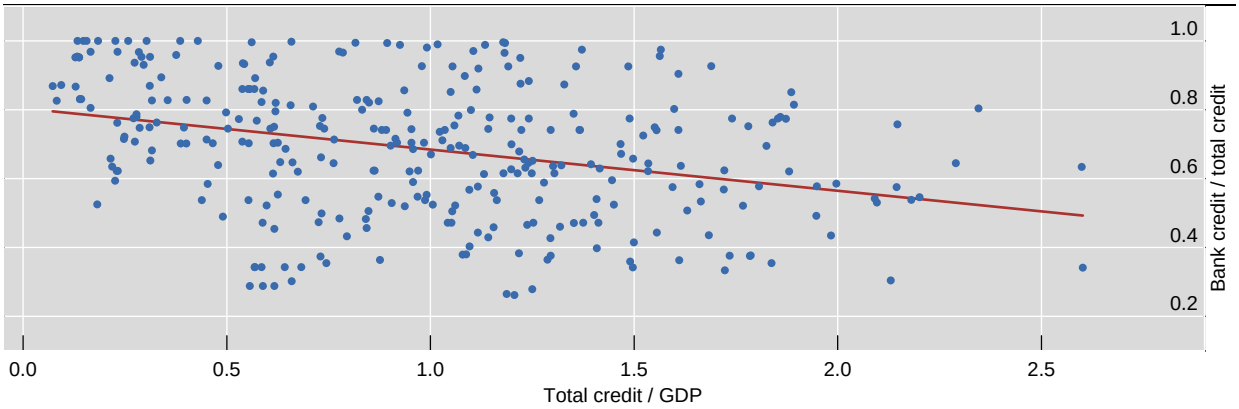
Source: National data.

[13] The Irish credit boom was driven by a massive increase in borrowing from both the household (Cusse and Phelan (2010)) and the corporate sector (Cusse and O'Leary (2013)). The stability of the credit-to-GDP ratio since the crisis reflects continuously high levels of borrowing by mainly multinational corporations. Intra-sector consolidation, which does, however, not net out cross-border intra-sector transactions, currently reduces the total debt of the non-financial private sector by 31% (Cusse and O'Leary (2013)), still implying a total (consolidated) credit-to-GDP ratio of 250%.

Total credit/GDP ratio versus ratio of bank credit to total credit

Five-year averages

Graph 2



The red line indicates the predicted results of a regression of the ratio of bank to total credit on credit-to-GDP ratios. The regression coefficient is statistically significant, but the R^2 is only 0.11.

Source: National data.

As in advanced economies, private sector credit developments in emerging economies (Graph 1, bottom panels) have been characterised by financial deepening and boom-bust episodes. This is exemplified by Thailand, where private sector borrowing rose from 12% of GDP in 1958 to 75% 30 years later. A rapid expansion in credit then followed that ended in the 1997 Asian crisis. Thailand's credit-to-GDP ratio nearly halved over the subsequent 13 years, but started to increase again from 2010 onwards.

Even though these country experiences suggest that private sector borrowing was much lower than GDP before the 1980s, this was not observed everywhere. This is apparent from a group of rather diverse economies including the Nordic countries, Japan and Switzerland (top right-hand panel of Graph 1). In the 1960s and 1970s, credit-to-GDP ratios were already around 100–150% – similar to the current levels in Canada and Germany.

Bank credit versus total credit

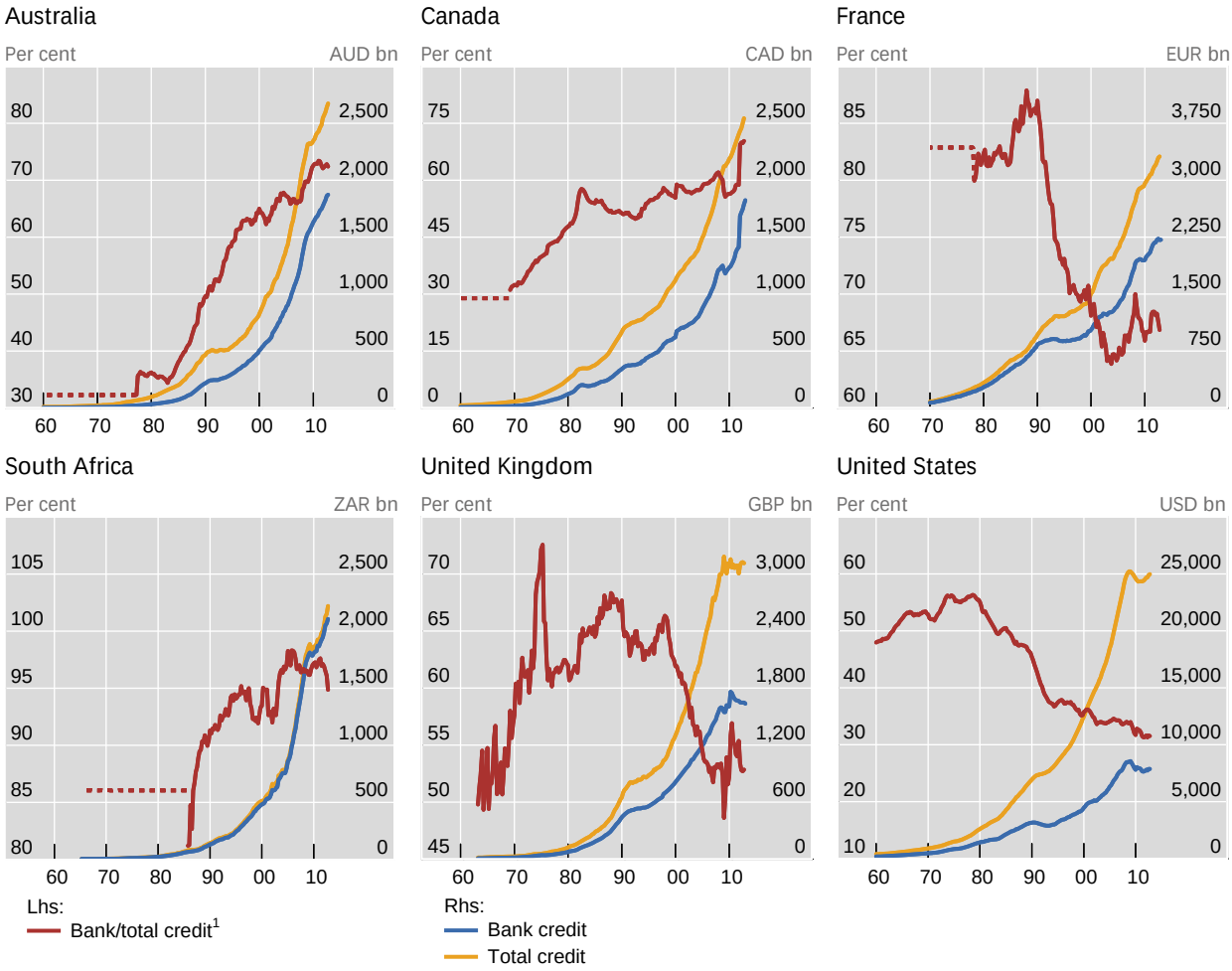
How much of total credit is provided by banks? The average for the whole sample is 70%, but this number varies greatly across countries and over time. Banks may extend only around 30% of total credit, as is currently the case in the United States, or close to 90% in heavily bank-based systems such as Germany or Greece.

While intuition may suggest that domestic banks become a less important source of credit with increased financial development, the relationship has historically been less clear-cut. A simple regression indicates that the share of bank credit in total credit decreases with financial development, as proxied by the total credit-to-GDP ratio.[14] Yet, as Graph 2 highlights, this link is far from strong.

[14] Following Levine and Zervos (1998) and Rajan and Zingales (1998), the literature often approximates financial development by the ratio of bank credit to GDP.

Total and bank credit

Graph 3



[1] A dotted line indicates that total credit series were approximated by domestic bank credit only. Level differences between both series in this case are due to break adjustments.

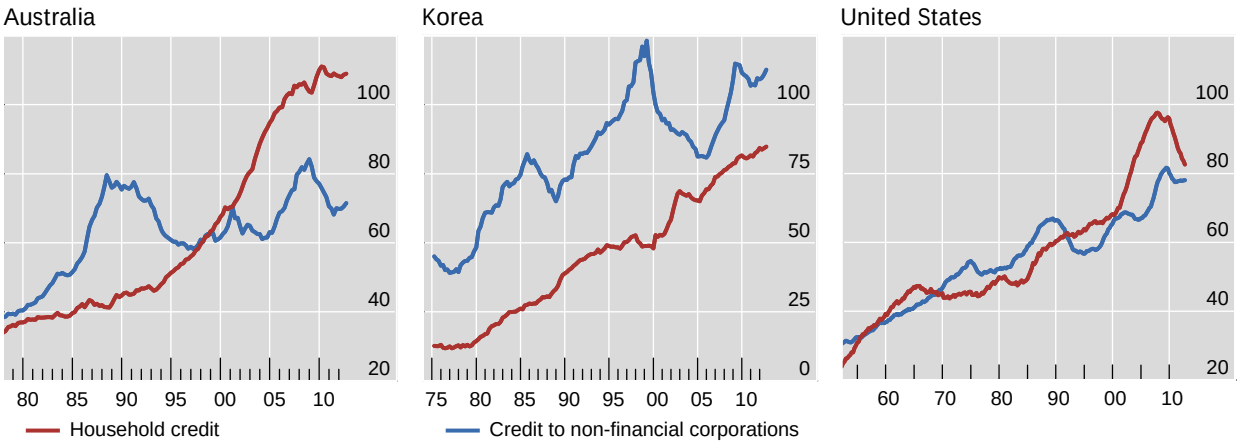
Source: National data.

In fact, in several countries domestic banks have become significantly more important providers of credit over time (Graph 3). This has occurred in both emerging markets and advanced economies. For example, Australia has highly developed banks, deep financial markets and a current total credit-to-GDP ratio of 180%. Yet the ratio of bank credit to total credit has increased steadily, from around 35% in the 1970s to more than 70% in 2012. This development was driven by the dismantling of tight regulation that had led to the emergence of a large shadow banking sector. In addition, the substantial increase in household borrowing was mainly satisfied by the banking sector (Edey and Gray (1996)).

Graph 3 also illustrates how securitisation can potentially distort the measured amount of bank credit, as discussed above. In Canada, bank credit jumped by around 25% in 2011, even though total credit grew by less than 5%. Rather than being driven by fundamental changes in market structure, this reflected the transition from Canadian Generally Accepted Accounting Principles (GAAP) to IFRS, which forced previously off-balance sheet items onto banks' balance sheets. The

Household credit and credit to non-financial corporations

As a percentage of GDP — Graph 4



Source: National data.

recorded volume of bank credit thus increased, even though the actual provision of credit to the economy did not change.

Developments in household and corporate credit

Over the last 40 years, most economies have seen an increase in household credit. This is particularly the case for emerging market economies, where household borrowing generally constituted only 10–20% of total credit at the time data are first collected (typically the 1990s) but has risen to 30–60% more recently. This corresponds to current levels in advanced economies, many of which experienced a similar trend. In several cases, such as Australia or the United States, the level of household credit now exceeds corporate sector borrowing (Graph 4). In the United States, this was already the case in the 1960s, although total credit levels were much lower then.

In addition to these slow-moving trends, household and corporate credit growth can diverge substantially in the short run. Across countries the average correlation between real household and real corporate annual credit growth is just 40%. It is therefore not surprising that there have been several episodes when corporate credit growth slowed but household borrowing expanded rapidly (or vice versa), such as after the dotcom bust in the United States and Australia or the Asian financial crisis in Korea (Graph 4).

Conclusion

This special feature introduced new long-run series for total credit compiled for 40 advanced and emerging market economies. BIS statisticians constructed these series with the help of central banks. The article explains the key concepts underlying the compilation of the new series including a description of the high

level statistical criteria applied, the characteristics of the underlying series used and the statistical techniques employed. It also identifies some of the problems faced by compilers and examines how they were addressed. The BIS will continue to expand the total credit series back in time, increase the country coverage and, where possible, further enhance the comparability of the series across time and countries. In general, the data will be updated on a quarterly basis and released on the BIS website.

For illustration purposes, the article explored some facets of the historical evolution of total credit. The data confirm that in most economies credit has risen substantially relative to GDP, often starting from levels below 50% to reach up to 300% and more now. However, several countries already had high levels of private sector borrowing in the 1960s, with credit-to-GDP ratios between 100% and 150%. Similarly, the data gathered in the long-run series show that bank lending has not necessarily become less important than other sources of funds for the private sector. And sectoral credit developments reveal a structural shift towards more household credit. In some countries, households now borrow even more than corporates.

References

Avdjiev, S, R McCauley and P McGuire (2012): "Rapid credit growth and international credit: challenges to Asia", in V Pontines and R Siregar (eds), *Exchange rate appreciation, capital flows and excess liquidity: adjustment and effectiveness of policy responses*, SEACEN Centre, June. Also available as *BIS Working Papers*, no 377.

Bloomberg, G, J Hokkanen and S Kåhre (2012): "Tax planning may have contributed to high indebtedness among Swedish companies", *Economic Commentaries*, Sveriges Riksbank, no 3.

Chow, G C and A-l Lin (1971): "Best linear unbiased interpolation, distribution and extrapolation of time series by related series", *Review of Economics and Statistics*, vol 53, no 4, pp 372–5.

Committee on the Global Financial System (2012): "Improving the BIS international banking statistics", *CGFS Publications*, no 47.

Cusse, M and B O'Leary (2013): "Why are Irish non-financial corporations so indebted?", *Central Bank of Ireland Quarterly Bulletin*, no 1.

Cusse, M and G Phelan (2010): "Irish households: assessing the impact of the economic crisis", *Central Bank of Ireland Quarterly Bulletin*, no 4.

Edey, M and B Gray (1996): "The evolving structure of the Australian financial system", in M Edey (ed), *Proceedings of a conference: The future of the financial system*, Reserve Bank of Australia.

European Commission (2012): "European Commission scoreboard for the surveillance of macroeconomic imbalances", *European Economy Occasional Papers*, no 92.

European Communities, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations and World Bank (2009): *System of National Accounts 2008*.

International Monetary Fund (2000): *Monetary and Financial Statistics Manual*.

International Monetary Fund and Financial Stability Board (2009): *The financial crisis and information gaps*, report to the G20 Finance Ministers and central bank Governors.

Levine, R and S Zervos (1998): "Stock markets, banks, and economic growth", *American Economic Review*, vol 88, no 3, pp 537–58.

McGuire, P and P Wooldridge (2005): "The BIS consolidated banking statistics: structure, uses and recent enhancements", *BIS Quarterly Review*, September, pp 73–86.

Rajan, R G and L Zingales (1998): "Financial dependence and growth", *American Economic Review*, vol 88, no 3, pp 559–86.