



## UNCONVENTIONAL MONETARY POLICIES—RECENT EXPERIENCE AND PROSPECTS\*

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### EXECUTIVE SUMMARY

- This paper addresses three questions about unconventional monetary policies. First, what policies were tried, and with what objectives? Second, were policies effective? And third, what role might these policies continue to play in the future?
- Central banks in the United States, United Kingdom, Japan, and euro area adopted a series of unconventional monetary policies with two broad goals. The first was to restore the functioning of financial markets and intermediation. The second was to provide further monetary policy accommodation at the zero lower bound. These two goals are clearly related, as both ultimately aim to ensure macroeconomic stability. But each relies on different instruments: the first on targeted liquidity provision and private asset purchases, and the second on forward guidance and bond purchases.
- These policies largely succeeded at achieving their domestic goals, and were especially effective at the time of greatest financial turmoil. Market functioning was broadly restored, and tail risks declined significantly. Policies also decreased long-term bond yields, and in some cases credit spreads. Growth and price stability also benefited, although findings are less clear cut, given the long lags and unstable relations between variables, and the unresolved question of counterfactuals.
- Unconventional monetary policies had a mixed effect on the rest of the world. Early announcements buoyed asset prices globally, and likely benefited trade. Later announcements had smaller effects and increased capital flows to emerging markets, with a shift to Latin America and Asia. Sound macroeconomic policies can help manage these capital flows. Yet, when flows become excessive, with the risk of sudden reversals, they can give rise to policy strains in recipient countries.
- Looking ahead, unconventional monetary policies may continue to be warranted if economic conditions do not improve or even worsen. Yet, their growing scale raises risks. Some of these can be mitigated with macroprudential policies. A key concern is that monetary policy is called on to do too much, and that the breathing space it offers is not used to engage in needed fiscal, structural, and financial sector reforms. These reforms are essential to ensuring macroeconomic stability and entrenching the recovery, eventually allowing for the unwinding of unconventional monetary policies.

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## Glossary

ABS	Asset-Backed Securities
APD	Asia and Pacific Department
APP	Asset Purchase Program
BOE	Bank of England
BOJ	Bank of Japan
CME	Comprehensive Monetary Easing
ECB	European Central Bank
EME	Emerging Market Economy
ETF	Exchange Traded Funds
FAD	Financial Affairs Department
Fed	U.S. Federal Reserve
FLS	Funding for Lending Scheme
FOMC	Federal Open Market Committee
GFSR	Global Financial Stability Report
LSAP	Large Scale Asset Purchase
LTROs	Long Term Refinancing Operations
MBS	Mortgage-Backed Securities
MCM	Monetary and Capital Markets Department
NPV	Net Present Value
OIS	Overnight Index Swap
OMT	Outright Monetary Transactions
QQME	Quantitative and Qualitative Monetary Easing Program
REITS	Real Estate Investment Trusts
RES	Research Department
SMP	Securities Market Program
SPR	Strategy, Policy, and Review Department
TALF	Term Asset Backed Securities Loan Facility
UMP	Unconventional Monetary Policies
WEO	World Economic Outlook
ZLB	Zero Lower Bound

**1. Central banks in advanced economies have deployed a variety of unconventional policies during the crisis.** This paper reviews recent experience with these policies and considers issues related to their continued use in the future. Part 1 of the paper provides a conceptual framework that links specific policy instruments and objectives. While the ultimate goal is macroeconomic stability, it is convenient to distinguish two objectives: (i) restoring the proper functioning of financial markets and financial intermediation; and (ii) providing further monetary policy accommodation at the zero lower bound. Part 2 examines the effectiveness of policies to date. It finds that they have been mostly successful at achieving their domestic goals, and that spillovers to other countries have—thus far at least—been benign overall. Part 3 looks at future policy options. While additional unconventional measures may be appropriate in some circumstances, there may be diminishing returns, and benefits will need to be balanced against potential costs.

## A CONCEPTUAL FRAMEWORK

*This section offers a conceptual framework to make sense of the wide array of unconventional monetary policies (UMP) pursued in advanced economies. Policies are generally seen as falling into two categories: those to restore the proper functioning of financial markets and intermediation, and those to provide further monetary policy accommodation at the zero lower bound. The first category includes liquidity provision and outright purchases of private and public assets. The second category covers both purchases of government bonds (bond purchases) as well as forward guidance.*

**2. Prior to the crisis, central banks in advanced economies navigated calm and familiar seas.** Monetary policy was conducted in a relatively predictable and systematic way, and its transmission mechanism was reasonably well understood. The key policy tool was a short-term interest rate, while monetary aggregates and the exchange rate were by and large free to adjust. A transparent central bank reaction function (or broad rule) guided market expectations of future interest rates. Well-functioning arbitrage ensured that actual and expected changes to short-term rates would be transmitted along the yield curve of sovereign bonds and across private asset classes, including bank loans. In the presence of nominal rigidities, these changes in nominal returns affected real interest rates and hence, real economic decisions such as consumption and investment. Transmission also took place through the impact policy rate changes had via the credit channel, the exchange rate channel, and the wealth channel.

**3. The crisis challenged this model along three dimensions.** First, widespread financial disruptions weakened or broke arbitrage conditions, hindering the transmission of policy rate changes along the yield curve, across asset classes, and to credit spreads.<sup>1</sup> Second, heightened vulnerabilities led some markets to freeze (coordinating on “bad” self-fulfilling equilibria, akin to

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<sup>1</sup> Adrian and Shin (2009).

what happens during bank runs). And third, the severity of the recession pushed the optimal policy rate below the zero lower bound (ZLB) on nominal interest rates.

**4. Central banks in advanced economies responded with unconventional tools to address two broad objectives:** first, to restore the proper functioning of financial markets and intermediation, and second to provide further monetary policy accommodation at the ZLB. The two objectives, while conceptually distinct, are closely related.<sup>2</sup> Both ultimately aim to support macroeconomic stability, including by diminishing tail risks in acute phases of the crisis (collapse of the financial system, depression, and deflation).

## A. Restoring Financial Markets and Intermediation

**5. Financial markets and financial intermediation became impaired for three main reasons.** The first is the classical problem of rational runs, in which the market can coordinate on a “bad” equilibrium in which it is rational for investors to run on a bank, sovereign, or market.<sup>3</sup> The second is more simply the collapse of confidence in certain institutions or markets, because of counterparty risk and the broader fragility of financial systems. The third, observed not only in crises but also in recessions, is the self-reinforcing amplification of asset price cycles and borrowing constraints (or other financial frictions). In this setting, lower asset prices weaken balance sheets and lead to tighter borrowing constraints and higher funding costs, requiring further asset sales. These, in turn, further depress asset prices and amplify the credit contraction.<sup>4</sup> Examples are provided below.

**6. Central banks responded by expanding dramatically their traditional role as lenders-of-last-resort.** This role as traditionally conceived was to provide liquidity to a subset of solvent banks facing temporary constraints on deposit and interbank funding. In the recent crisis, instead, disruptions also affected the interlinked funding markets for nonbank intermediaries and for sovereigns, as well as some derivatives markets.<sup>5</sup> Central banks in some cases became market makers of last resort.

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<sup>2</sup> A large macroeconomic shock could push the optimal policy rate below the ZLB without necessarily causing a financial crisis; financial disruptions could occur while the policy rate remains in positive territory. The U.S. came close to the ZLB in the mid-2000s, despite no financial crisis.

<sup>3</sup> Diamond and Dybvig (1983), Gorton (2009).

<sup>4</sup> Kiyotaki and Moore (1997), Curdia and Woodford (2011), Gertler and Karadi (2011), Eggertsson (2012). There are additional reasons for the impairment of financial intermediation and credit provision. These, however, have less to do with market imperfections, and are thus less amenable to monetary policy action. Incentive structures within banks and financial regulation can constrain the supply of credit (see Goodhart and Ashworth, 2013, for a full discussion). Debt overhangs can diminish the demand for credit. More generally, macroeconomic risks will weigh on both the supply of and the demand for credit. While monetary policy can help, fiscal and financial regulatory policies are also important.

<sup>5</sup> Greece, Ireland, Italy, Portugal, Spain, and more recently Cyprus.

**7. Acute risks to, and failures of, financial market functioning were mostly met with aggressive liquidity provision.** Targeted liquidity provision mostly alleviated the problems of rational runs and the collapse of confidence, by offering key backstops.<sup>6</sup> First, liquidity provision was extended to a wider set of recipients. In the United States (U.S.), these included nonbank entities such as securities firms and money market mutual funds. Second, targeted funding was provided to specific markets. An example is the extension of repo operations to commercial paper and asset-backed securities (ABS) in the U.S. Third, funding was offered at long maturities, for unlimited amounts, and against considerably expanded collateral, such as through the full-allotment Long-Term Refinancing Operations (LTROs) in the euro area and Term Auction Facility (TAF) in the U.S. Finally, funding schemes were used to provide a price backstop in certain highly volatile markets. Examples include the Term Asset-Backed Securities Loan Facility (TALF) in the U.S., and foreign exchange swap lines between central banks.<sup>7</sup> In the same spirit, the European Central Bank (ECB) purchased government bonds of euro area countries to address tensions hampering the monetary policy transmission mechanism. The ECB purchased assets outright through its Securities Markets Program (SMP), later replaced by the pledge to intervene more decisively through Outright Monetary Transactions (OMT).<sup>8</sup> All these programs had positive knock-on effects on financial intermediation, either by resolving bank funding strains or reinforcing bank balance sheets.

**8. Central banks also acted to support the more drawn-out weakness in financial intermediation, mostly by purchasing private assets.** The goal was to support key asset prices to prevent fire sale spirals, mitigate borrowing constraints on financial institutions, and lower borrowing costs. Examples include the funding for lending scheme (FLS) by the Bank of England (BOE) and purchases of mortgage-backed securities (MBS) and agency bonds by the U.S. Federal Reserve (Fed), bank covered bonds by the ECB, and commercial paper, corporate bonds, exchange traded funds, and real estate investment trusts by the Bank of Japan (BOJ). In addition to supporting financial stability, these measures lower borrowing costs and bolster credit to the real economy. Details of specific programs can be found in Table 1 in the Appendix.

## **B. Providing Further Monetary Policy Accommodation at the Zero Lower Bound**

**9. Real economic activity slowed sharply, inducing some central banks to cut policy rates aggressively.** Conventional policy rules implied negative nominal policy rates given the sharp decline in output and low inflation. Yet nominal rates are for most purposes bounded at (or near)

<sup>6</sup> Brunnermeier and Pedersen (2009), He and Xiong (2012), Brunnermeier and Sannikov (2012a, 2012b).

<sup>7</sup> TALF offered a price backstop through non-recourse repo loans, allowing cash recipients to put their collateral to the Fed if the price of the collateral decreased sufficiently. For a particularly clear discussion, see Sack (2010). Likewise, swap lines provided dollar funding to foreign institutions needing to finance dollar assets, undercutting the higher price of dollar liquidity on the Foreign Exchange Swap market (leading to the break-down of the covered interest parity condition—see Mancini-Griffoli and Ranaldo (2011) or Ivashina and others (2012) for a discussion).

<sup>8</sup> See ECB Research Bulletin <https://www.ecb.int/pub/pdf/other/researchbulletin17en.pdf>, for an analysis of the impact of bond purchases in the euro area (the SMP).

zero since the alternative to hold money (cash) yields zero interest. At or near the ZLB, central banks thus lost their conventional policy instrument.<sup>9</sup>

**10. As they neared the ZLB, central banks moved to target real long-term yields directly through forward guidance and government bond purchases.** Arguably, central banks always aim to affect real long yields, as these are often the rates most relevant for consumption, investment, and hiring. But in normal times, the link is indirect, as explained earlier. At the ZLB, instead, central banks can hope to affect real long yields directly, by decreasing long nominal yields and increasing inflation expectations. The ensuing depreciation of the currency, stemming from lower long-term interest rates, would further loosen monetary conditions.

**11. Forward guidance can also loosen monetary conditions, despite the ZLB.** In its most general form, forward guidance entails managing market expectations of future policy, with explicit communication (or other information) on the central bank's reaction function and economic projections. In normal conditions, it can help fine tune monetary policy communications. At the ZLB, however, forward guidance can be used to convince markets that the central bank will keep rates low for longer (allow inflation to go higher) than consistent with its usual policy rule (Eggertsson and Woodford, 2003, Eggertsson and Ostry, 2005, Woodford, 2012). If successful, this will decrease expected future nominal and real rates (flatten the yield curve), and create expectations of a stronger recovery. Of the central banks considered in this paper, both the Fed and BOJ strengthened forward guidance at the ZLB (see Table 1 in the Appendix).

**12. However, forward guidance poses a time inconsistency problem.**<sup>10</sup> Its effectiveness thus hinges on the credibility of the commitment. Preannounced thresholds for the timing and pace of the interest rate "lift-off" from the ZLB and purchases of long-term assets can help to enhance credibility by increasing the central bank's reputational and financial costs from early exit. Explicit policy rules, such as price-level or nominal-GDP-level targeting (described in Box 1), may also be used as commitment devices. On the whole, preannounced thresholds appear to be preferable to such rules.

<sup>9</sup> At the ZLB, reserves at the central bank and short term treasuries are nearly perfect substitutes, making the expansion of the balance sheet through purchases of short term treasuries irrelevant.

<sup>10</sup> The problem of time inconsistency is particularly acute for forward guidance at the ZLB. This is because the central bank tries to convince the market it will deviate from its old policy rule by allowing inflation (and output) to be higher in the recovery. Yet, once the recovery begins, it becomes optimal for the central bank to go back on its pledge to keep rates low, and raise interest rates in accordance with its old rule. Knowing this, the market may not believe the central bank's original promise to keep rates low for longer.



**Box 1. Price Level and Nominal GDP Level Targeting, or Thresholds?**

Flexible price level targeting or nominal GDP level targeting would aim to minimize price or nominal GDP level deviations from a predetermined path. The essential characteristic of such policies is history dependence. If either indicator drops below its target, the central bank would have to “make up for it” by generating higher inflation or nominal GDP growth in the future (and the opposite if the indicator exceeds the target). In theory, these policies would work as automatic stabilizers: prospects of higher inflation and growth following a recession would serve to support current economic activity. But both have important weaknesses.

*Price-level targeting* mostly loses its benefits if inflation is not very sensitive to economic slack (the Phillips curve is flat). Moreover, price level targeting may at times require very low inflation (or deflation) to offset a period of higher than average inflation. This could prove procyclical in a world with significant downward nominal rigidities.

*Nominal GDP level targeting* faces the complication of having to measure potential GDP growth and indeed nominal GDP in real time, knowing the measure is nearly always considerably revised, often with long lags. It also implies that any excessive optimism that policy makers have about the prospects for real GDP would translate into higher inflation. The strategy thus risks unanchoring inflation expectations, which could raise, not lower, interest rates through increased uncertainty about the central bank’s reaction function.

A possibly more promising approach may be to explicitly characterize the conditions or “thresholds” leading to an interest rate lift-off. While avoiding the pitfalls of the above rules, guidance based on thresholds continues to offer an automatic stabilizer, in the sense that as the economy weakens, expectations will automatically shift to a later lift-off date. Also, the conditions for lift-off can be set so as to explicitly signal the intention to provide a higher temporary policy stimulus than expected under traditional policy rules. Room for maneuver is limited, however, because the central bank would otherwise need to announce it is willing to accept an inflation rate much higher than its objective.

The Fed’s December 2012 announcement offers an example of threshold-based guidance. The Fed announced it would keep rates at the ZLB to the extent that long-term inflation expectations remain well anchored, until unemployment declines to 6.5 percent so long as inflation projections 1 to 2 years ahead have not risen above 2.5 percent, a level slightly above its inflation objective of 2 percent.

**13. Bond purchases can decrease long-term nominal yields through three channels.** The signaling channel functions under most economic conditions and is shared with forward guidance. The other two channels—scarcity and duration—are sometimes lumped together under the heading of “portfolio rebalancing” and require segmented markets. Segmentation arises, for example, when some investors prefer to hold or deal in certain assets (such as pension funds’ preference for long-term rather than short-term securities, or assets requiring particular risk management and clearing systems) and there is limited arbitrage, so that asset prices partly reflect the valuations of segmented investors.<sup>11 12</sup>

<sup>11</sup> Gromb and Vayanos (2002) or Garleanu and Pederson (2011), for instance, suggest arbitrage may be hindered in crises by funding liquidity and balance sheet constraints.

- **The signaling channel.** Bond purchases may convince markets that the central bank is committed to a loose policy stance. Simply announcing that policy will remain loose for long(er) may not be credible. Bond purchases support credibility if market participants perceive a rapid exit as either difficult or costly.<sup>13</sup> In this sense, bond purchases can usefully complement forward guidance.
- **The scarcity channel.** A very large buyer, such as the central bank, can reduce the supply of a specific bond available for trading. Investors with particular preferences for the bond will thus bid up its price (lower its yield), as well as that of close substitutes.<sup>14</sup>
- **The duration channel.** When long-maturity bonds are purchased in very large amounts by the central bank, investors' portfolios become safer (because less exposed to interest rate risk).<sup>15</sup> This will decrease the price of risk. As a result, investors will be willing to accept lower yields to hold all remaining bonds, implying a downward shift of the entire yield curve, as opposed to a change in yields only in the segment where purchases occurred as in the scarcity channel.<sup>16</sup>

**14. Bond purchases to stimulate aggregate demand were mostly made in the U.S., U.K., and Japan.** Specific programs are listed in detail in Table 1 in the Appendix. In the U.S., the first Large Scale Asset Purchase program (LSAP 1), from November 2008 to November 2009, saw purchases of Treasuries (US\$300 billion), as well as Agency debt (US\$175 billion) and MBS (US\$1.25 trillion). These latter purchases also aimed to restore financial market functioning and financial intermediation, as discussed earlier. LSAP 2 (US\$600 billion) ran from November 2010 to June 2011 and focused just on Treasuries. The Maturity Extension Program (MEP, commonly called “Operations Twist”) (US\$667 billion) ran from September 2011 to December 2012 and sold short-term in exchange for longer-term Treasuries. Finally, LSAP 3, the first open-ended program, began in September 2012 with a focus on Agency MBS and followed-up in December 2012 with Treasury purchases. In the United Kingdom, the first Asset Purchase Program (referred to as APP 1 in this paper) (£200 billion) ran from January 2009 and was eventually replaced with APP 2 (£175 billion), which began in October 2011. Both saw purchases of longer-term Gilts. Finally, the BOJ built on its

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<sup>12</sup> Under perfect markets, the purchase of longer term bonds should not have any effect, because the price of an asset is determined by its fundamentals and not by who owns it (Eggertsson and Woodford, 2003, Curdia and Woodford, 2011). Theoretically, if purchases of government bonds imply a permanent upward shift in the money supply, however, even under perfect markets they can have real effects because they increase inflation, lowering real interest rates and the real value of public debt (Auerback and Obstfeld, 2005).

<sup>13</sup> Purchases must therefore be accompanied by aggressive communication. The lack of a clear, complementary message has been cited as a reason for the small effect of BoJ asset purchases in the early 2000s (Eggertsson and Ostry, 2005).

<sup>14</sup> Clouse et al. (2003), Bernanke (2000).

<sup>15</sup> This is true of portfolios that are not held to maturity, as for pension funds, for instance, that purposefully invest in long-term bonds to match the maturity of their liabilities.

<sup>16</sup> For theoretical underpinnings see Vayanos and Vila (2009), or Greenwood and Vayanos (2010). For a discussion, see Joyce and others (2012), Krishnamurthy and Vissing-Jorgensen (2011), D’Amico and others (2011), or Cochrane (2008 and 2011).

experience with asset purchases by engaging in its Comprehensive Monetary Easing (CME) policy in October 2010 to purchase government bonds (as well as other private assets discussed earlier, total purchases of ¥76 trillion originally planned by end 2013). In April 2013, the BOJ announced the Quantitative and Qualitative Monetary Easing (QQME) program, which aims at increasing the monetary base by ¥60 to ¥70 trillion annually, mostly through purchases of government bonds (of longer maturity than in former programs), but also some private assets.<sup>17 18</sup>

## EVIDENCE OF EFFECTIVENESS

*This section considers the effectiveness and channels of unconventional policies. The focus is on instruments to provide further monetary policy accommodation at the ZLB, namely bond purchases and expanded forward guidance. Policies to restore market functioning and financial intermediation are also briefly discussed. The section also examines the cross-border spillovers of advanced country unconventional measures to emerging markets.*

**15. Estimating the macroeconomic effects of unconventional measures is challenging, and such estimates need to be approached with caution.** Ideally, these estimates require a counterfactual, that is, what would have happened absent policy action. This is especially true of early unconventional measures, introduced at a time of severe macroeconomic risks, including strong deflationary pressures and the threat of a financial sector meltdown. Yet, building an explicit counterfactual to be used in empirical work comes down to guess work. Models are notoriously poor at capturing crises (such as boom and bust cycles, rational runs, and other large deviations and nonlinear responses).<sup>19</sup> Moreover, past empirical regularities are unlikely to hold during a crisis.<sup>20</sup> Estimating the marginal effects of monetary policy announcements (forward guidance or bond purchases) on observable variables, such as interest and exchange rates, is easier and generally relies on event studies. This section focuses primarily on this narrower question, though it presents some evidence that early announcements significantly decreased tail risk.

### A. Restoring Financial Markets and Intermediation

**16. Policies to avoid acute risks to, or major impairments of, financial markets were generally highly effective.** The TALF in the U.S. led to the return of liquidity in the securitized credit markets, and cross border money market arbitrage resumed following the foreign exchange swap

<sup>17</sup> Chapter 3 of the April GFSR illustrates the increase in central bank balance sheets stemming from these various programs.

<sup>18</sup> Other central banks also resorted to unconventional monetary policies in response to the financial crisis. These included foreign exchange interventions by the Swiss National Bank and the Bank of Israel, negative interest rates on excess reserves by the Danish National Bank, and conditional forward guidance by the Bank of Canada.

<sup>19</sup> De Nicolo and Luccheta (2010) address some of these issues in a VAR setting.

<sup>20</sup> See Saborowski and Weber (2013), and the 2008 GFSR for a discussion of the pass-through of policy rates to lending rates during tranquil and crisis times.

lines. Both programs became obsolete relatively quickly, as market conditions normalized.<sup>21</sup> In the euro area, the three-year full-allotment LTROs avoided massive bank deleveraging and an ensuing contraction in credits, following frozen interbank markets in December 2011 (Ciccarelli and others, 2013 and Paries and others, 2013). Likewise, while no transaction materialized, the announcement of OMT significantly decreased bond yields in euro area countries under market stress, thus strengthening bank balance sheets and to some extent limiting potential sovereign-bank linkages.

**17. Private asset purchases to support financial intermediation show positive results, though mostly in the U.S.** In the first phase of LSAP 1, the Fed purchased mortgage-backed securities (MBS) and Agency bonds at a time when the spread over Treasuries was unusually high, in a sign of market dysfunction. LSAP 1 appears to have decreased MBS yields by 150 bps (Krishnamurthy and Vissing-Jorgensen, 2010), and mortgage rates by nearly 50 bps (Hancock and Passmore, 2011). It is still too early to gauge the effectiveness of the FLS program in the U.K. Further evidence, though, suggests that the effects of private asset purchases differ across types of assets. The purchase of corporate bonds, Exchange Traded Funds (ETFs), and Japanese Real Estate Investment Trusts had significant effects at the introduction of the BOJ's CME (Lam, 2011, Ueda, 2012). Yet, the effects appear limited for pre-2010 purchases of ABS in Japan.

**18. Financial intermediation remains broken in euro area countries under market stress.** The banking sector, responsible for most of the credit allocation in the euro area, remains weak in some countries, despite the positive announcement effects of OMT noted above. Impaired assets are high, profitability low, and loss absorption capacity is weak. Bank funding costs, as a result, remain elevated. In turn, interest rates on new loans have been rising, while those in euro area countries with stronger economies have been decreasing. Chapter 1 of the April 2013 GFSR (IMF 2013b) provides a more complete discussion. The ECB, though, remains constrained in its ability to directly support financial intermediation relative to other central banks. Its influence over bank regulation is limited for now, and securitized credit markets are thin.

**19. Where financial intermediation remains impaired, the effects of further policy accommodation on lending, and ultimately growth, are dampened.** In the U.S. and core euro area countries, lower bond yields seem to have been passed through to lower lending rates, in turn supporting credit volumes (Japan exhibits a flatter pattern). In the U.K. and euro area countries under market stress, instead, credit volumes as a share of GDP have been contracting (especially to non financial corporates). In these countries, lending rates have not always followed lower bond yields, or the policy rate. See Figure 5 in the Appendix for an illustration, and Chapter 1 of the April 2013 GFSR (IMF 2013b) for further evidence.<sup>22</sup> On this basis, it would seem there is still scope to improve financial intermediation in selected countries.

<sup>21</sup> See Sack (2010) for a discussion of the effects of the TALF and Mancini-Griffoli and Ranaldo (2011) for evidence of the effects of foreign exchange swap lines.

<sup>22</sup> Goodhart and Ashworth (2012) provide further evidence of the break-down in lending, as suggested by the dramatic drop in the money multiplier (the ratio of broad money to base money). Bowman and others (2011) finds

(continued)

## B. Forward Guidance and Policy Accommodation

**20. Empirical evidence broadly supports the view that forward guidance affected long-term interest rates already in conventional times.** Generally, the literature finds that central bank statements affect not only the current interest rate but also its future path in a way that cannot be summarized by the change in the targeted policy rate only. Campbell et al. (2012) find that, for the U.S. over a sample covering conventional times, 90 percent of variation in the expected federal funds rate four quarters ahead can be attributed to factors not related to surprises in the timing of changes in the policy target.

**21. One problem is that forward guidance conveys information about both a central bank’s future policy reactions and about its views on output and inflation.** Only the first is relevant to measuring the effectiveness of forward guidance, but even event studies (which control for factors non-simultaneous with the announcement) cannot distinguish whether expectations about future policy rates change because of changes in beliefs about the central bank’s reaction function or because of changes in expected economic conditions (Woodford 2012). This identification problem may be especially acute at the ZLB, since central banks are likely to announce a prolonged period of low interest rates in conjunction with deteriorating views for output and inflation. Hence, changes in expected interest rates are not necessarily evidence of the effectiveness of forward guidance.

**22. This said, studies that control for the relationship between macro expectations and long-term rates suggest that forward guidance has been at least partly effective during the crisis.** Swanson and Williams (2012) show that the sensitivity of long-term government bond yields to macroeconomic news declines after explicit forward guidance. Likewise, Woodford (2012) shows how the “extended period of time” language of the U.S. Federal Reserve and the Bank of Canada statements (April 21, 2009) on conditional forward guidance lowered expectations of future interest rates, as measured by Overnight Index Swap (OIS) rates.<sup>23</sup>

**23. Forward guidance is less effective when it fails to signal a deviation from the central bank’s “normal” reaction function.** That may have been the case in Sweden, speculates Woodford (2012), as markets did not align their interest rate projections with those published by the central bank. Similarly, the BOJ’s forward guidance during 1999–2000 had a negligible effect (Ugai, 2007). In

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some evidence of UMP boosting credits in Japan, while Peersman (2011) and Lenza and others (2010) explore the historical relationship between monetary policy and credits. Gambacorta and Marquez-Ibanez (2011) find micro-level evidence that banks most exposed to market funding most cut back on lending, suggesting that measures to restore market functioning should have encouraged credit growth.

<sup>23</sup> The one-year OIS decreased about 10 bps on April 21, 2009 following the Bank of Canada statement. Likewise, the two-to-five-year OIS decreased by around 10 bps following the August 9, 2011 and January 25, 2012 announcements by the Fed. On these last two dates, 10-year bond yields decreased by just under 10 bps, a considerable amount, comparable to the effects of LSAP2. These dates are particularly appropriate for a study of forward guidance, as they did not contain other policy announcements. Such is not the case for the Fed’s December 12, 2012 announcement of “thresholds” to raise rates, making it much harder to disentangle the (potentially greater) direct effects of forward guidance.

contrast, the later BOJ conditional commitment to maintain zero interest rates (along with the concurrent expansion of its balance sheet) significantly decreased bond yields (up to 40–50 bps for three to five-year bonds and 20 bps for 10-year bonds).

### C. Asset Purchases and Policy Accommodation

#### 24. This section asks four separate questions, each requiring a different analytical method.

- What were the effects of bond purchases on long-term yields? Answers are based on cumulating changes in long-term yields on days with announcements of bond purchases (an “event study” approach). Effects on exchange rates—also an important channel to loosen monetary conditions—are investigated in the section on spillovers.
- Have bond purchases also been effective if a control is introduced for the extent to which markets were surprised on announcement days? This approach involves a regression analysis on event days, and also examines the following more specific questions: were purchases effective at decreasing yields and—importantly—alleviating tail risks, and how effective were bond purchases relative to conventional rate cuts?
- What were the main transmission channels for bond purchases—signaling, scarcity, or duration? The question is important as it can inform the strategy of purchases and their intended effects.<sup>24</sup> To distinguish between channels, the literature and staff compare the effects of bond purchases across different assets.
- Have bond purchases been effective at stimulating the economy? The preferred method is to gauge the response of growth and inflation to a long-term interest rate shock, in an empirical model.

#### Total effects of bond purchases on long-term bonds

25. **Effectiveness of bond purchases is difficult to gauge even relative to the intermediate target of lowering long-term bond yields.** A multitude of factors affect yields at any given time, and these are difficult to disentangle.

- **The preferred approach in the literature to isolate the effect of purchases is event studies.** This entails measuring changes in yields in a very narrow time window—typically one day—around an official announcement related to bond purchases. There are two main assumptions underlying this approach: (i) on the day it is made, the announcement dominates all other

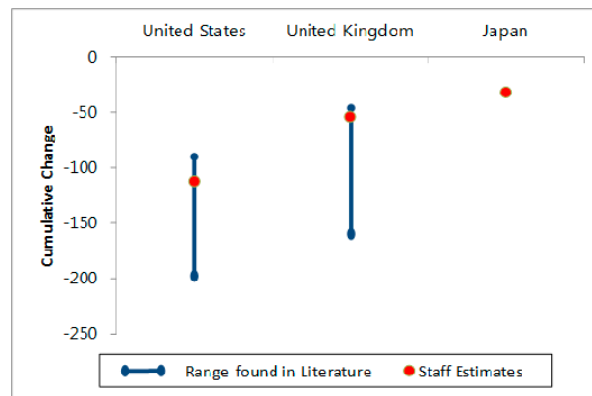
<sup>24</sup> If the signaling channel is most relevant, for instance, it may be preferable to tie purchases to forward guidance and possibly to observable thresholds. Scarcity or duration channels would instead call for larger and more rapid purchases. Also, as discussed further below, the scarcity and duration channels seem to be less effective at supporting growth and price stability.

shocks to bond yields; and (ii) bond prices are forward looking and react immediately and accurately to anticipated future purchases.

- **Though a powerful tool, event studies have limitations.** First, they may misestimate the effect of purchases if they fail to control for the surprise element of announcements. In many cases, announcements are at least in part expected, or can disappoint markets. In addition, responses to the content of announcements (usually positive for the economy) can be undercut by the simultaneous downbeat economic assessment motivating the announcement (usually a negative for the economy). Second, because of their focus on a short time window, event studies may miss more persistent changes in yields.<sup>25</sup>

**26. With these caveats in mind, the evidence suggests that bond purchases significantly reduced long-term yields, especially following early announcements, at the peak of domestic market turmoil.** In the U.S., the cumulative effects of bond purchase programs are estimated to be between 90 and 200 bps, as shown in Figure 1 (estimates vary depending on methodologies and event windows). Most studies focus on LSAP 1 where the largest effects are found (between 50 bps and 100 bps). In the U.K., cumulative effects range from 45 bps to 160 bps. In Japan, staff estimates that purchases of government bonds under the CME and QQME policies reduced 10-year yields by a little over 30 bps (because few estimates exist in the literature for Japan, no range is given). Table 2 more systematically summarizes findings from the most relevant studies in the literature.

**Figure 1. Cumulative Effects of Bond Purchases on 10-Year Government Bonds**



Sources: Literature (see Appendix Table 2), Bloomberg and staff calculations. Note, some estimates for the range are derived visually from graphs. Some papers study changes in bond prices over a two-day window following announcements; staff estimates consider a one day window.

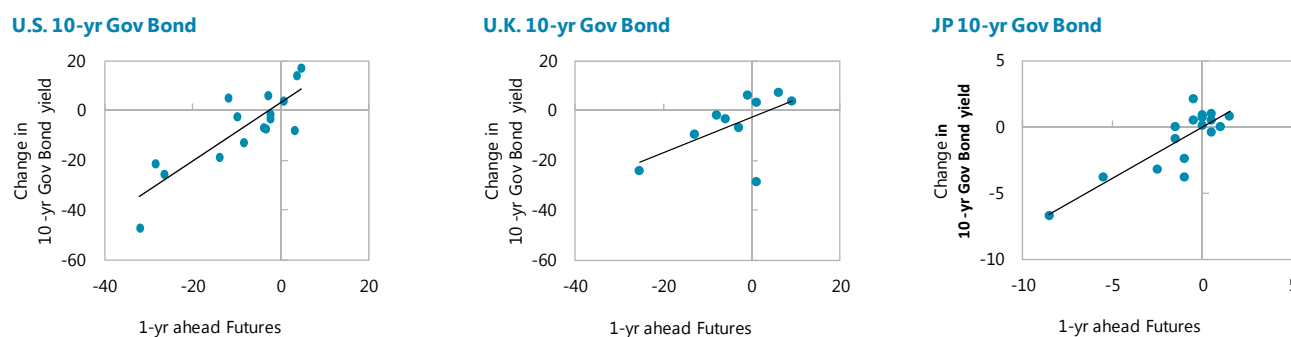
### Effectiveness of bond purchases and the role of surprises

<sup>25</sup> In order to gauge the persistence of effects, a full-fledged model would be necessary to control for all other factors affecting bond yields. Such models would also be adequate to study effects of actual (and fully expected) bond purchases. Yet, the fit of these models is known to be very poor.

**27. In investigating the effectiveness of bond purchases, it is desirable to account for the surprise element of each announcement.** Accordingly, some papers<sup>26</sup> and staff explore the bang (change in yields) for the buck (degree of surprise) of announcements. Staff (shared with Chapter 3 of the April 2013 GFSR) measure surprises by changes in one year ahead futures on short-term interest rates, as futures to some extent reflect market expectations of policy moves to come (the change in futures on a policy announcement day reflects the surprise associated with the announcement).<sup>27</sup> The best fit lines in Figure 2 suggest that bigger surprises had bigger effects on yields (including disappointing—positive—surprises which increased yields). The significant relationships further suggest that a 25 bps decrease in one year ahead futures would decrease 10-year bond yields, on average, by 25 bps in the U.S. and 20 bps in the U.K. and Japan.<sup>28</sup>

**Figure 2. Effectiveness of Bond Purchases**

Yield responses to surprises related to bond purchases, as proxied with futures on interest rates.



Source: Bloomberg.

**28. The effectiveness of monetary surprises associated with bond purchases appears similar to that of conventional rate cuts prior to the crisis.** In other words, changes in bond yields per unit of surprise were similar pre and post-crisis. This does not mean, of course, that total

<sup>26</sup> Few papers attempt to account for the surprise of purchases. These include Rosa (2012) and Joyce and others (2011).

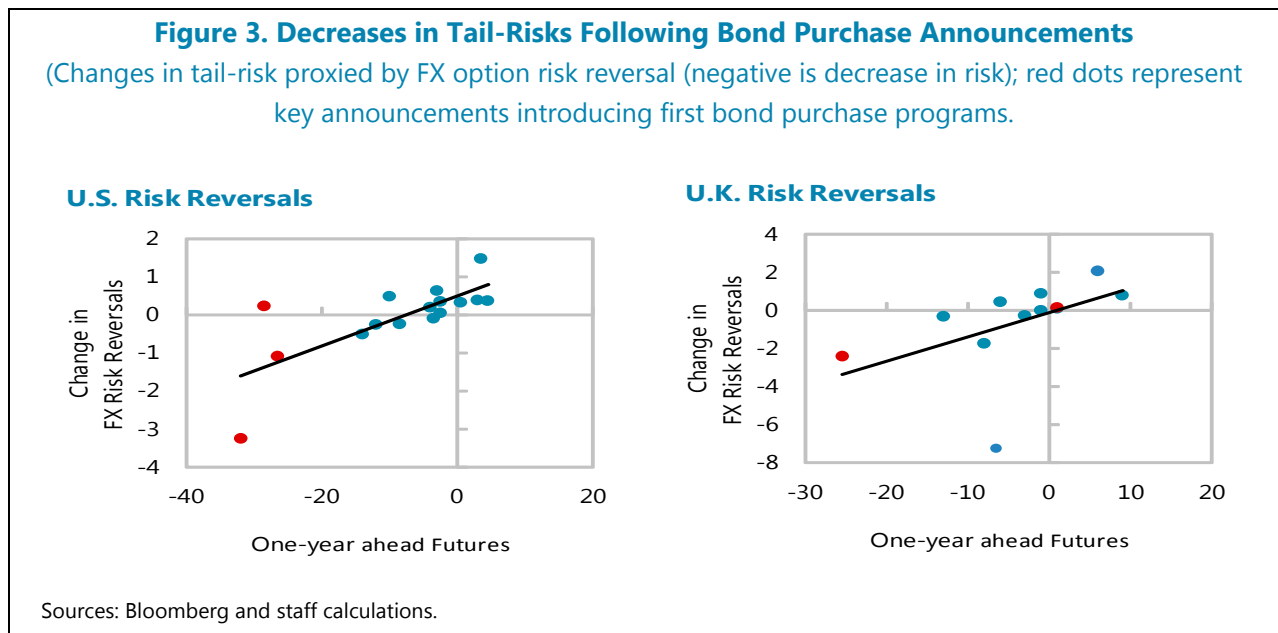
<sup>27</sup> One year ahead futures on 90-day Libor is used for each currency of interest. The approach follows the literature; see for instance Gurkaynak, Sack and Swanson (2005) or Woodford (2012) for a discussion. The advantages of using one-year ahead futures are discussed in the Background Paper. The QQME announcement was not included in this particular analysis, as a meaningful measure of policy surprise could not be extracted from the near-zero futures on short-term interest rates.

<sup>28</sup> Ideally, one would want to know the effectiveness of an amount of purchases, say of US\$100 billion. Yet, no measure exists of the dollar amount by which markets were surprised at the time of announcements. Moreover, the relationship between the amount spent and the size of the surprise as measured above can be unstable (not even monotonically increasing).



effects on bond yields were constant throughout, as surprises differed substantially.<sup>29</sup> Announcement surprises, as defined above, hold for both the periods of conventional and unconventional monetary policies. It is thus possible to compare the effects of announcements using a simple regression analysis covering announcement days (regression results are summarized in Table 4, and discussed in more detail in the Background Paper).<sup>30</sup>

**29. Initial announcements were especially effective at easing financial conditions, partly by decreasing tail risks of a severe recession.** This finding goes some way towards addressing the counterfactual of no policy action. Following Chapter 1 of the October 2012 GFSR, tail risks here are measured by the probabilities attributed to large foreign exchange swings (highly liquid foreign exchange (FX) option risk-reversals). As shown in Table 4, and illustrated in Figure 3, these significantly decreased, on average, following announcements of bond purchases. Earlier announcements (red dots in the figure) appear to have had the largest effects. Evidence from surveys corroborates these results. The skewness of inflation forecast distributions<sup>31</sup> decreases noticeably after the first announcements of bond purchases, suggesting that deflation (or very low inflation) tail risks were reduced.



<sup>29</sup> The average surprise in the U.S. pre-crisis was around 7 bps, whereas the surprises associated with the first announcements of bond purchases were between 20 bps and 50 bps.

<sup>30</sup> The analysis comes down to running two regressions:  $y_{it} = a_i + b_i x_{it} + e_{it}$ , where  $t$  denotes sampled announcement days and  $i$  is used to indicate the two subsamples of interest ( $i=1$  over the pre-crisis, conventional sample and  $i=2$  over the post-crisis, unconventional sample),  $y$  indicates a yield on an asset and  $x$  the monetary policy surprise. The question is whether  $b_1 = b_2$ .

<sup>31</sup> Distributions are built from individual forecasts of one year ahead inflation expectations, from Consensus Economics.

## Channels of transmission for bond purchases

**30. Evidence points to the prevalence of the signaling channel, though the scarcity and duration channels occasionally played important roles.** In the U.S., and for LSAP 1, the literature and staff find balanced evidence for the signaling and portfolio rebalancing channels (which is mostly associated with scarcity, though one paper finds evidence of duration, and appears prevalently in LSAP 1A, when MBS purchases were first announced).<sup>32</sup> The few papers that look into further programs (LSAP 2 and 3), including staff estimates, continue to find evidence of the signaling channel, though scarcity seems to have played a role in LSAP 3, again coinciding with MBS purchases. According to staff estimates, the BOJ’s comprehensive monetary easing (CME) purchases also seem to have affected government bond yields through the signaling channel (though scarcity effects may be present relative to equity purchases).<sup>33</sup> Staff analysis further suggests that MEP (commonly called “Operation Twist”), in the U.S., appears to have worked through the duration channel, as expected, as it involved investors exchanging long-term bonds for short-term bonds. Over the fewer observations in the U.K., the literature and staff mostly find evidence of the portfolio rebalancing channel (both scarcity and duration), perhaps due to more segmented markets relative to the U.S. Results from the literature are summarized in Table 2, and staff estimates are described in detail in the Background Paper.

**31. The signaling channel seems to have the largest macroeconomic effects.** On average, staff find that a decrease in long-term yields coming through the signaling channel has an effect on GDP growth approximately twice as large as the same shock coming through the portfolio rebalancing channels. The result is consistent with theory. Shocks to long-term rates due to the portfolio rebalancing channel may be expected to be more temporary and reversible, in part due to the volatile market conditions on which this channel relies. Stein (2012) provides another explanation: lower premia on riskier long-term bonds induced by portfolio rebalancing might lead firms to buy back shorter-term debt with longer-term issuance, instead of fostering productive investments.

## Effects on the economy

**32. The literature and staff find that bond purchases significantly improved macroeconomic conditions, although there is considerable uncertainty about the size of the impact.** Both GDP growth and inflation reacted positively and substantially to bond purchases. Effects, though, were short-lived. Yet, they were more persistent for inflation than for output. The

<sup>32</sup> The empirical strategy to disentangle the various channels is two-fold. One approach rests on models to extract expectations of future policy rates as well as the term premium from long rates (assuming that the signaling channel mostly affects expectations of policy rates while the portfolio channels affect the term premium). Another approach is model free, but rests on a careful comparison of price reactions across assets, which each channel is supposed to affect differently. More details are offered in the Background Paper. It should be noted that the signaling channel does not necessarily have to be prevalent. For instance, Bernanke and others (2004) find effects of asset purchases by Japan’s Ministry of Finance, where signaling effects were clearly not present.

<sup>33</sup> Based on staff estimates extending the work of Lam (2011).

size of the effects varies widely, depending on the method used and the sample period for estimation. Researchers have used structural macro models, as well as VAR models, typically estimating the effects of a 100 bps drop in long-term bond yields. Others, focusing on inflation expectations, instead resorted to event studies. Detailed findings from the literature are presented in Table 3. Most papers find that GDP growth increases around 2 percentage points in the U.S. and U.K. (generally lasting around two years), although the range is very large (between 0.1 percentage and 8 percentage points). Effects on inflation are as large as 3.6 percentage points, though again within a wide range.

**33. Staff estimates underline the uncertainty around these results owing to the time-varying relationship between both growth and inflation, and bond yields.** Interestingly, the instability in the parameters of the relationship does not seem to materialize just with the crisis. Parameters have been generally unstable throughout the sample, starting in the mid 1980s.<sup>34</sup> This said, there are reasons to believe that the financial crisis in particular perturbed the historical relationships between long-term rates and the macroeconomy, not least because the banking and financial intermediation channels became impaired, as suggested earlier.<sup>35</sup>

## D. International Spillovers

**34. How have unconventional measures in the major advanced economies affected the rest of the world as well as each other?** This question, while simply posed, is difficult to answer. It might, for example, be addressed using a full general equilibrium model with effects judged against a counterfactual of no policy action in advanced economies. In this context, monetary policy easing would be beneficial to all countries by helping prevent a sharper deterioration in global output and financial conditions. Yet, current models do not capture well the effects of UMP, capital flows, foreign exchange volatility, ensuing risks to financial stability, or sudden reversals. In addition, as discussed earlier, the proper counterfactual is open to debate. One extreme counterfactual is the spillover from monetary mistakes and a prolonged slump such as the Great Depression. As discussed in Box 3 in the Appendix, the costs to Latin America—at the time of the Great Depression a region highly integrated with the advanced economies of the day—were very large. However, it is not clear whether these historical precedents would also have applied in the current crisis.

**35. The analysis below focuses on three measures of spillovers through asset prices and international capital flows.** First, an event study using the same announcement surprises developed above draws out the immediate effects of policy announcements on foreign bond yields,

<sup>34</sup> Parameter instability is also emphasized in the literature; see Wheelock and Wohar (2009) for a survey. Further details may be found in the Background Paper.

<sup>35</sup> There may also be other reasons. For instance, wealth effects are bound to have decreased. Historically these mostly came from dividends and higher share prices. Lower long rates, instead, increase wealth through discounted future income streams which cannot be so easily consumed. Bech and others (2012) empirically investigate how the transmission channel of monetary policy changes following financial crises.

equity prices, exchange rates, and money market rates.<sup>36</sup> Second, the analysis is complemented by a study of weekly flows into U.S.-based emerging market bond and equity funds. Finally, a review of aggregate developments in capital flows is used to capture the more persistent trends not captured by the event analysis.

**36. Results suggest that foreign financial spillovers from unconventional measures are largest when policies restore market stability or significantly change the monetary framework.**<sup>37</sup> LSAP 1, which met these criteria, led to major global financial market rallies, involving generalized reductions in bond yields, rises in equity prices, and appreciation of foreign currencies vis-à-vis the U.S. dollar. Early announcements of asset purchases in the U.K. had similar exchange rate effects. Later U.S. announcements, instead, had either more muted effects on all foreign assets (such as LSAP 3), or even negative effects on equities and bond yields (such as following the Fed’s MEP). The same is true of earlier Japanese announcements, which in addition tended to appreciate the yen relative to foreign currencies. In these cases, it appears that market repricing of yen-denominated assets at times of high uncertainty in the rest of the world, as well as the signal of a worse than expected global conjuncture, dominated the direct impact of the easing.<sup>38</sup> By contrast, the BOJ’s announcement of a dramatic change in its monetary policy in April 2013 (the announcement of QQME) again had strong financial spillover effects.<sup>39</sup>

**37. The Outright Monetary Transactions (OMT) announcement by the ECB further highlights the importance of the market stability signal.** The announcement of this new monetary instrument raised bond yields in some core euro area countries and in much of the rest of the world, but significantly lowered bond yields in the euro area periphery.<sup>40</sup> This reduction in tail risks in the euro area—a concern that was weighing heavily on financial markets—led to a generalized rally in global equity markets.

**38. Weekly flows into U.S.-based emerging market bond and equity mutual funds suggest that earlier interventions drew money back to the U.S. while later ones sent money abroad.**

<sup>36</sup> Efforts were made to control for the cross-border patterns of asset price correlations so as to more precisely isolate the direct links between one country’s announcement of asset purchases and another’s reaction. Further details on the methodology and results are presented in the Background Paper.

<sup>37</sup> The impact on market stability is greatest when policies remove tail risks related to a particular policy uncertainty or market imperfection.

<sup>38</sup> These results are consistent with the existing literature on capital flows to emerging markets, which emphasizes the importance of growth differentials and market stability for capital flows, in addition to interest rate differentials. See IMF (2012c) for comprehensive discussion, as well as IMF (2010; 2011a; 2011b; 2011c) and Ghosh and others (2011).

<sup>39</sup> The QQME announcement led to a generalized fall in bond yields of around 10 bps, an appreciation of foreign currencies vis-à-vis the Japanese Yen of about 3 percent, and a widespread fall in foreign equity prices of around 2 percent. This last reaction is notably different from those following other announcements. One interpretation is that given the depreciation of the yen, investors moved into stocks of Japanese firms and out of other, foreign stocks.

<sup>40</sup> For an event study analysis of the OMT announcements, see Altavilla and others (2013).

The analysis focuses on the impact of U.S. policy announcements and associated bond purchases as these are the most likely to influence flows into U.S. retail products (although more nimble trades by professionals are not included). The results suggest that Fed liquidity injections and LSAP announcements in the early part of the crisis (that stabilized U.S. markets in the aftermath of the Lehman collapse) induced a substantial rebalancing in global portfolios, with investors repatriating capital from abroad to U.S. markets. However, later LSAP announcements (that generally buoyed foreign market sentiment) seem to have boosted capital flows to emerging markets, underlining again the importance of market conditions on the impact of policies. These results are also consistent with similar analysis by others.<sup>41</sup>

**39. Thus far, capital flows to emerging markets have been ample but not alarming.** After a brief sudden stop over the crisis, flows have moved back close to the ample levels seen in the run up to the crisis (Figure 4). The most recent data, though partial, suggest a renewed pick-up of flows in late 2012. Post-crisis flows also have a similar structure, involving significant amounts of debt creating bond and bank (other investments) inflows that tend to be more closely associated with credit growth and financial instability. By contrast, there is a very different geographic pattern with more flows to Asia and Latin America compared to the pre-crisis focus on Eastern Europe.<sup>42</sup> While a number of factors such as high commodity prices and growth imply that these flows could be structural, legitimate concerns about a sudden change in global market sentiment remain.

**40. The impact of unconventional measures on other countries also depends on the cyclical position of the recipient and on market imperfections.** A boost to domestic demand from lower bond yields, higher equity prices, and a reduction in tail risks to the global economy can be helpful if an economy is operating below capacity, but complicate policy making if an economy is above capacity. In addition, domestic currency appreciation, while a normal reaction to necessary monetary accommodation abroad, is easier to deal with if the currency is not already overvalued relative to fundamentals. More generally, effects on EMEs can be destabilizing if amplified by market imperfections and relatively shallow markets. The limited ability to absorb capital and the tendency to trade on short-term trends can cause excessive currency appreciation and volatility, unsustainable credit expansion, and asset price bubbles (including in commodities, especially those held as assets, like oil). These could eventually undermine financial stability. In addition, because decisions on UMP tend to be less easy to predict, they tend to be associated with times when it is more difficult to anticipate the future path of global monetary and financial conditions.

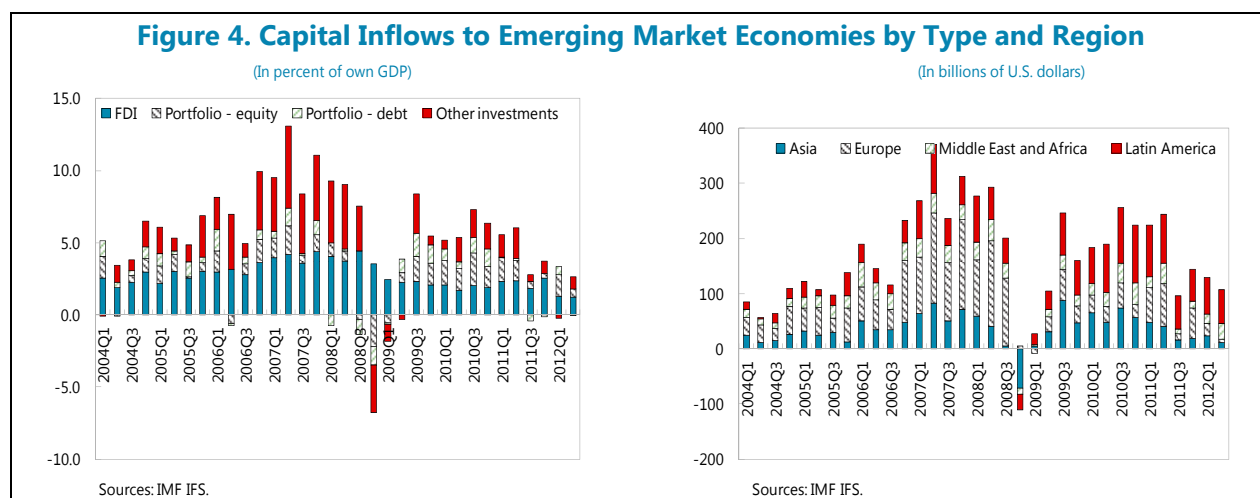
**41. That said, capital inflows can often be adequately managed.**<sup>43</sup> Doing so has implications for policies in both the recipient and source countries. In recipient countries, sound macroeconomic policies will be essential, including rebalancing the monetary and fiscal policy mix, allowing currencies to appreciate if not overvalued, and building reserves if these are not more than

<sup>41</sup> See Fratzscher and others (2012).

<sup>42</sup> The same picture emerges when looking more specifically at bank intermediated flows by region.

<sup>43</sup> Details on policies to manage capital flows may be found in IMF (2012c).

adequate. For addressing systemic financial sector risks, macroprudential measures also play an important role.<sup>44</sup> In certain circumstances, introducing capital flow management measures may also be appropriate to temporarily support needed macroeconomic adjustment. Outcomes could be improved if policy makers in source countries take into account how their policies affect global economic and financial stability. Greater attention to the cross-border coordination of policies would also help to mitigate the riskiness of capital flows, even though more analysis may be needed to fully understand the implications of such coordination.<sup>45</sup>



**42. The impact of unconventional measures on other countries may well be changing over time, although there is as yet no firm evidence of this.** To the extent that UMP have in the past helped to lower uncertainty and tail risks, their effects, including via capital flows, have tended to be broadly benign or at least balanced. If, however, their ongoing use induces advanced economies to avoid more fundamental reforms, the relative attractiveness of emerging markets to investors could increase further, and the balance may shift.

## LOOKING AHEAD

*This section asks whether further unconventional measures can still be counted on to ease monetary conditions if the economy remains weak. It also presents some key issues that central banks engaged in unconventional measures need to consider. These are intended to inform the policy debate, and not provide specific policy prescriptions.*

<sup>44</sup> Countries can better absorb capital flows and reap their benefits by also deepening financial markets, strengthening financial regulation and supervision, and improving institutional capacity. This will be particularly relevant in the face of potential reversals of capital flows at the time of exit.

<sup>45</sup> To this end, it would be helpful to complete and fully implement the national and international regulatory and supervisory reforms now underway.

**43. Whether further unconventional measures in advanced economies are warranted will depend on circumstances.** The analysis and evidence in this paper support the view that UMP were most warranted and most effective at the height of the crisis, when severe financial distress led to market segmentation and the breakdown of arbitrage conditions. UMP were also effective in supporting aggregate demand despite the ZLB, once financial markets normalized, but to a lesser extent. As economies start to recover, financial distress continues to abate, and the ZLB constraint is relaxed, the case for UMP will wane. The challenge at that point would be an orderly exit from exceptionally easy monetary conditions. In contrast, should conditions worsen, with no undue risk of inflation, UMP would likely continue to be appropriate (especially following renewed shocks to the functioning of financial markets and intermediation). It is in the intermediate scenario of a sluggish recovery that net benefits of pursuing UMP are more ambiguous, and that weighing benefits against potential costs (reviewed further below) will be more challenging. Naturally, the benefits of UMP must be seen within certain limits: monetary policy cannot by itself solve structural banking problems or raise potential growth in the medium and longer runs.<sup>46</sup>

**44. An important question about further recourse to UMP is whether bond purchases and forward guidance will face diminishing effectiveness in stimulating aggregate demand.** Theory suggests that diminishing returns will kick in beyond a certain point. First, effects through the signaling channel are likely to wane. Bond purchases (and forward guidance to some extent) will lose effectiveness as longer-maturity bond rates approach the ZLB. In order to continue to lower expected real rates, central banks will have to commit to keep policy rates low for an increasingly longer horizon; but the longer the horizon, the lower the credibility of the commitment.<sup>47</sup> (This is separate from the issue of frontloaded announcements probably being more effective than gradual ones in signaling the central banks commitment to low interest rates). Second, the portfolio rebalancing channels of bond purchases rely on some degree of market segmentation. Thus, they will weaken as health in the financial sector is restored and arbitrage conditions strengthen.<sup>48</sup> Yet, if market functioning remains impaired, the portfolio rebalancing channels should continue to operate, even if the signaling channel wanes. This would reduce, though not completely undercut, UMP effectiveness. From a policy perspective, the bottom line is that diminishing returns will

<sup>46</sup> The relevant literature goes back as far as Friedman (1968), Lucas (1972), but also King (1981), Goodfriend and King (1981), King and Plosser (1984), or Clarida, Gali and Gertler (2005). Monetary policy, however, could have some effect on potential growth through hysteresis effects of persistent unemployment.

<sup>47</sup> The argument relative to forward guidance mostly applies to the U.S., which has already implemented aggressive forward guidance. Other countries may have more scope to provide further monetary policy accommodation through forward guidance.

<sup>48</sup> In more normal markets, arbitrage can be expected to return and smooth price differences between market segments. Signs of renewed arbitrage can be found in lower deviations from covered interest parity—a fundamental arbitrage condition between national money markets; see Mancini-Griffoli and Ranaldo (2011), or Ivashina and others (2012) for a discussion. Also, as long-term bond yields drop, bonds become increasingly substitutable with non-interest bearing money. Thus, central bank purchases of bonds with money will result in diminishing marginal portfolio rebalancing; see Cochrane (2011) for a thorough discussion. For unchanged market conditions, though, portfolio rebalancing effects could actually get stronger with the size of purchases, since the last investors to sell to the central bank have the highest propensity to pay (stronger preferences) for the assets. This point has not been developed explicitly in the literature, however.

eventually affect any bond purchase strategy, whatever its design and initial effects. Policy makers most likely need to either accept this diminishing impact or adopt new and more radical policy frameworks over time.

**45. Some evidence on diminishing effectiveness exists, though it is not conclusive and comes with caveats.**<sup>49</sup> Comparisons across time are difficult as bond purchase programs and their economic settings vary. For instance, consistent with theory, the announcement of LSAP 1 in an environment of acute uncertainty had a visibly bigger impact on bond yields than LSAP 2, a trend that seems to have continued with later programs. The same is true of the effect on tail risks. This suggests that further increases in asset purchases would have incrementally smaller effects. That said, it is possible that the difference in the measured response was due to the fact that early announcements exceeded expectations more than later ones (as suggested by staff estimates in the Background Paper). Also, evidence mostly relates to the extension of similar bond purchase programs. A substantially different program, either in size or scope, could still have strong effects, as suggested by the BOJ's April 2013 QQME announcement. Likewise, a program announced against the backdrop of renewed economic weakness and uncertainty could have greater effects. Finally, further UMP actions are likely to have asymmetric effects. For instance, the unexpected suspension of current programs would likely lead to higher yields.

**46. Other types of unconventional measures might be deployed to offset the declining effectiveness of bond purchases and forward guidance, but these pose greater implementation challenges and risks.**

- Central banks could try to push nominal rates into negative territory, and some have already taken small steps in this direction. But implementation hurdles are substantial (negative interest rates are bounded below by the interest rate equivalent of the cost of holding cash, and would impair the functioning of interbank and derivatives markets).
- Central banks could purchase private assets, such as corporate or bank debt, as well as equities, or real-estate and other physical assets. An example is the Bank of Japan's Stock Purchasing Program. Such purchases may be warranted, as pointed out earlier, if they are temporary and help alleviate a targeted distortion in financial markets or intermediation. Otherwise, private asset purchases are more fiscal in nature. Outside of the immediate emergency of a crisis, central banks usually have neither a comparative advantage, nor the political legitimacy to engage in such policies, although legal frameworks differ across countries.

**47. The potential costs or risks associated with continued unconventional measures (and more generally prolonged loose monetary conditions) will also need to be managed.**

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<sup>49</sup> As noted previously, following renewed negative shocks or market tensions, asset purchases would likely have greater effects, especially when they provide a backstop to an unstable market, such as with OMT in the euro area.



- **Banks and other intermediaries may increase their liquidity risk in expectation of central bank intervention.**<sup>50</sup> Over the medium-run, policy should seek to contain the unintended consequences of such necessary actions. Widening supervision and regulation to non-bank institutions that—as the crisis demonstrated—are also exposed to runs and can benefit from liquidity provision could help contain the costs of liquidity injections. Further progress in ending “too big to fail” and improving the resolution of financial institutions is also desirable.
- **Greater risk taking behavior, spurred by accommodative monetary policies, could undermine financial stability.** Of particular concern is the possible mispricing of credit risk, riskier positioning by weaker pension funds and insurance companies, and a rise in liquidity risk, particularly in countries where recoveries are more advanced. In emerging market economies, corporations may start taking on more debt and foreign exchange exposure. While valuations have not yet reached stretched levels (except in a few hotspots), sensitivity to higher global interest rates and market volatility has increased across asset classes.<sup>51</sup> The first line of defense is not to tighten monetary policy early, as this would halt the broader recovery. Instead, financial stability risks could be mitigated initially with appropriate macroprudential policies, both in countries engaged in, and exposed to, UMP.<sup>52</sup>
- **Delayed reforms may hinder future monetary policy effectiveness through a conflict of objectives (real or perceived).** As discussed above, low interest rates favor loan evergreening and lower the cost of public sector borrowing, reducing incentives for financial restructuring and fiscal consolidation. Once inflation begins to rise, policy rate hikes could threaten financial and fiscal stability.<sup>53</sup> Political pressure will mount to balance these different needs. This may lead to outright fiscal dominance (especially since purchasing bonds to provide necessary monetary policy accommodation is observationally equivalent to monetizing debt). And even where central banks continue to adhere to their original mandate, the presence of these conflicts could reduce central bank credibility<sup>54</sup> and increase the costs of stabilizing inflation.<sup>55</sup> These risks could

<sup>50</sup> Farhi and Tirole (2011). To some extent, the same problem could apply to central bank purchases of risky private assets, although these are less predictable than liquidity provision.

<sup>51</sup> See Chapter 1 of the April 2013 GFSR (IMF 2013b) for more details, and Chapter 3 (IMF 2013c) for a more in depth analysis of the impact of UMP on financial stability.

<sup>52</sup> The appropriate use of macroprudential policies is discussed in Viñals (2011).

<sup>53</sup> Financial institutions could suffer from a rapid policy tightening in three ways, though of course these should be offset by the improving economic conditions accompanying exit: (i) lower margins on fixed interest loan portfolios (to the extent that banks are hedged against interest rate risk, the institutions holding the other end of such contracts would come under strain); (ii) mark-to-market losses on assets; and (iii) higher defaults on loans from debtors surprised by, and unable to cover, higher interest payments. Net interest margins of banks could increase, however, as rates move away from the zero lower bound, since banks could charge a higher spread between deposit and lending rates. Also, with higher rates, there would be less incentive to search for yield—another factor offsetting the above concerns.

<sup>54</sup> Cottarelli and Viñals (2009) discuss the costs of and limits of decreasing debt burdens through inflation. Yet, the current high debt environment is fertile terrain for a misinterpretation of objectives, and is an incentive for governments to exercise pressure. For instance, staff estimates (discussed in detail in the Background Paper) suggest that inflation of 6 percent annually between 2013 and 2017 would reduce the net debt-to-GDP ratio by about 10 percentage points for most G7 countries (other than Japan and Italy, where the effect would be larger). However, if inflation

(continued)

be severe if UMP were adopted by central banks with weak credibility.<sup>56</sup> This underscores the importance of policy coordination to avoid a vicious circle in which further monetary policy accommodation takes pressure off financial sector, fiscal, and structural reforms, and in turn the lack of reforms requires increasingly accommodative, though possibly less effective, monetary policy. These reforms are essential to ensuring macroeconomic stability and entrenching the recovery, eventually allowing for the unwinding of unconventional monetary policies.

- **Large and potentially volatile capital flows to other countries could persist or increase, with the potential for future abrupt reversals.** As noted previously, recipient countries can resort to specific measures to manage the effects of capital inflows, including macroprudential policies for addressing financial sector risks. And countries that generate large capital flows should internalize better the spillovers from their monetary and prudential policies by considering combinations of policies that achieve the same domestic objectives but minimize the impact on others. Although the uncertain transmission process may complicate this task, sound prudential frameworks in source countries would help mitigate the multilateral risks associated with global liquidity creation.<sup>57</sup>

**48. Finally, orderly exit from exceptionally easy monetary conditions may prove challenging.** There are two main risks, discussed in more detail in Box 2 and the Background Paper:<sup>58</sup>

The transmission of policy could be bumpy when central banks begin to tighten and shrink their balance sheets. The crisis may have changed the relationship between various interest rates, and there is little experience in advanced economies with running monetary policy in the presence of large excess reserves. While this may be mainly a question of proper policy calibration, the risk is interest rate volatility and overshooting in the adjustment of long-term rates. The potential sharp rise in long-term interest rates could prove difficult to control, and might undermine the recovery (including through effects on financial stability and investment). It could also induce large fluctuations in capital flows and exchange rates.

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expectations become unanchored, the economic and human cost of subsequently bringing inflation down could be very high. Also, an older literature exists on the costs of financing government debt; see for instance, Cottarelli (1993), Cukierman (1992), or Leone (1991). Jacome and others (2012) reviews the institutional limitations on central bank lending to the government.

<sup>55</sup> With lower credibility, the inflation-output tradeoff worsens as central banks have to increase interest rates more aggressively to dampen inflationary pressures. Goodfriend and King (2005) provide an illuminating review of the Volcker disinflation and the costs associated with limited central bank credibility. Alternatively, see Freedman and Laxton (2009) or Chapter 1 of the April 2013 World Economic Outlook (WEO). In addition, Espinoza and others (2012), and Khan and Senhadji (2001) suggest that high inflation becomes a significant drag on growth.

<sup>56</sup> Only very few other central banks than those already engaged in UMP might be able to successfully implement these policies at this stage. See Jacome and others (2012) for an empirical investigation.

<sup>57</sup> IMF (2012c), p. 36.

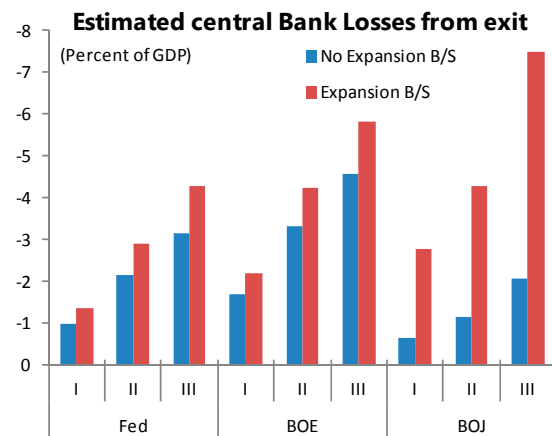
<sup>58</sup> Chapter 3 of the April GFSR (IMF 2013c) discusses financial stability risks associated with exit.

- Political interference could increase as central bank profit transfers to government diminish or disappear during the tightening cycle, as central banks make higher interest payments on reserves and realize losses from selling assets to shrink their balance sheets. Absent actual or feared political interference, however, central bank losses and the size of balance sheets should not constrain the implementation of monetary policy.

### Box 2. Potential Costs of Exit to Central Banks

**Losses to central bank balance sheets upon exit are likely to stem from a maturity mismatch between assets and liabilities.**

In normal circumstances, higher interest rates—and thus lower bond prices—would lead to an immediate valuation loss to the central bank. These losses, though, would be fully recouped if assets were held to maturity. Two things have changed with the current policy environment: (i) balance sheets have grown enormously, and (ii) assets purchased are much longer-dated on average and will likely not roll-off central bank balance sheets before exit begins. Thus, valuation losses will be amplified and become realized losses if central banks sell assets in an attempt to permanently diminish excess reserves. But central banks will not be able to shrink their balance sheets overnight. In the interim, similar losses would arise from paying higher interest rates on reserves (and other liquidity absorbing instruments) than earning on assets held (mostly fixed coupon payments). This would not have been the case in normal times, when there was no need to sell significant amounts of longer-dated bonds and when most central bank liabilities were non-interest bearing (currency in circulation). (The ECB is less exposed to losses from higher interest rates as its assets—primarily loans to banks rather than bond purchases—are of relatively short maturity and yields of its loans to banks are indexed on the policy rate; the ECB is thus not included in the estimates of losses that follow).



**The table below shows the net present value (NPV) estimate of losses in three different scenarios.** Losses are estimated given today's balance sheet (no expansion) and the balance sheet that would result from expected purchases to end 2013 (end 2014 for the BOJ, accounting for QQME). Losses are estimated while assuming everything else remains unchanged (notably absent capital gains or income from asset holdings).<sup>1</sup> This is because losses are estimated in net present value terms, in response to a shift in the yield curve. To simplify the analysis and facilitate cross country comparisons, no stance is taken as to the precise path and timing of exit. Losses do not necessarily imply asset sales. Even if bonds are held to maturity, the net present value cost of absorbing liquidity with higher short-term rates over the term of the bonds would be approximately equal to selling the bonds outright today. These losses—which may be significant even if spread over several years—would impact fiscal balances through reduced profit transfers to government. Scenario 1 foresees a limited parallel shift in the yield curve by 100 bps from today's levels. Scenario 2, a more likely case corresponding to a stronger growth scenario requiring a steady normalization of rates, suggests a flatter yield curve, 400 bps higher at the short end and 225 bps at the long. The scenario is similar to the Fed's tightening from November 1993 to February 1995, which saw one year rates increase by around 400bps. Losses in this case would amount to between 2 percent and 4.3 percent of GDP, depending on the central bank. Scenario 3 is a tail risk scenario, in which policy has to react to a loss of confidence in the currency or in the central bank's commitment to price stability, or to a severe commodity price shock with second round effects.

**Box 2. Potential Costs of Exit to Central Banks (cont'd)**

The short and long ends of the yield curve increase by 600 bps and 375 bps respectively, and losses rise to between 2 percent and 7.5 percent of GDP. (Scenarios 2 and 3 foresee somewhat smaller hikes for the BOJ, given the persistence of the ZLB).

**The appropriate sequence of policy actions in an eventual exit is relatively clear.** A tightening cycle would begin with some forward guidance provided by the central bank on the timing and pace of interest rate hikes. It would then be followed by higher short-term interest rates, guided over a first (likely lengthy) period by central bank floor rates (which can be hiked at any time, independently of the level of reserves) until excess reserves are substantially removed. Term open market operations (“reverse repos” or other liquidity absorbing instruments) would be used to drain excess reserves initially; outright asset sales would likely be more difficult in the early part of the transition, until the price of longer-term assets had adjusted. Higher reserve requirements (remunerated or unremunerated) could also be employed. In fact, central banks could theoretically maintain their large balance sheets until assets naturally came to maturity.

**The transmission of policy, though, is likely to somewhat bumpy in the tightening cycle associated with exit.** Reduced competition for funding in the presence of substantial excess reserve balances tends to weaken the transmission mechanism. Though higher rates paid on reserves and other liquidity absorbing instruments should generally increase other short-term market rates (for example, unsecured interbank rates, repo rates, commercial paper rates), there may be some slippage, with market rates lagging. This could occur because of market segmentation, with cash rich lenders not able to benefit from the central bank’s official deposit rate, or lack of arbitrage in a hardly operating money market flush with liquidity. Also, there may be limits as to how much liquidity the central bank can absorb at reasonable rates, since banks would face capital charges and leverage ratio constraints against repo lending.

**There is also a risk that even if policy rates are raised gradually, longer-term yields could increase sharply.** While central banks should be able to manage expectations of the pace of bond sales and rise in future short-term rates—at least for the coming 2 to 3 years—through enhanced forward guidance and more solid communication channels, they have less control over the term premium component of long-term rates (the return required to bear interest rate risk) and over longer-term expectations. These could jump because leveraged investors could “run for the door” in the hope of locking in profits, because of expected reverse portfolio rebalancing effects from bond sales, uncertainty over inflation prospects or because of fiscal policy, financial stability or other macro risks emerging at the time of exit. To the extent a rise in long-term rates triggers cross-border flows, exchange rate volatility is bound to increase, further complicating policy decisions.

<sup>1</sup> McLaren and Smith (2013) arrive at different estimates of losses for the Bank of England as they focus on losses net of capital gains and income from asset holdings.

**49. The path ahead will be challenging, with many unknowns.** Staff will continue building capacity in this critical area of policy, and investigate the merits of policy options in a range of conditions, some adverse and others looking further ahead into tranquil times. A planned future Board paper will synthesize the results of this work, as well as conclusions from this paper and reflections on the output-inflation tradeoffs (Chapter 3 of the April 2013 World Economic Outlook, IMF 2013a) and the impact of loose monetary conditions on financial stability (Chapters 1 and 3 of the April 2013 Global Financial Stability Report, IMF 2013b and 2013c).

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## Appendix. Supplemental results and Analysis

<b>Appendix Table 1. Selected Recent Unconventional Monetary Policies</b>			
<b>Country</b>	<b>Date</b>	<b>Program</b>	<b>Description</b>
<b>Forward Guidance</b>			
U.S.	12/16/2008		The Federal Open Market Committee (FOMC) "anticipates...exceptionally low levels of the federal funds rate for some time."
U.S.	3/18/2009		The FOMC "anticipates...exceptionally low levels of the federal funds rate for an extended period."*
U.S.	9/13/2012		The FOMC "will continue to maintain interest rates extremely low until at least mid-2015."*
U.S.	12/12/2012		The FOMC "decided to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that this exceptionally low range for the federal funds rate will be appropriate at least as long as the unemployment rate remains above 6-1/2 percent, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committee's two percent longer-run goal, and longer-term inflation expectations continue to be well anchored."
Japan	10/5/2010		The bank "will maintain the virtually zero interest rate policy until it judges, on the basis of the understanding of medium-to long-term price stability."
Japan	1/22/2013		The bank announces an inflation target of two percent in addition to open-ended asset purchases.*
Japan	4/4/2013		The bank announces its intention to meet its 2 percent price stability target over about 2 years.
<b>Bond Purchases</b>			
U.S.	3/18/2009	LSAP1	The FOMC announces it will purchase longer-term Treasury securities (US\$300 billion) over the next six months.* It had expressed intention to do so earlier on 1/28/2009 and Chairman Bernanke had expressed intention on 12/1/2008. On 8/12/2009 the FOMC decided to "gradually slow the pace" of Treasury purchases and removed "up to" language with reference to Treasury purchase limit.
U.S.	11/3/2010	LSAP2	The FOMC "intends to purchase a further US\$600 billion of longer term Treasury securities by the end of the second quarter of 2011, a pace of about US\$75 billion per month." The FOMC expressed intention of purchasing longer-term Treasuries on 8/10/2010 and 9/21/2010. Chairman Bernanke expressed intention on 8/27/2010.
U.S.	9/21/2011	MEP	The FOMC "intends to purchase, by the end of June 2012, US\$400 billion of Treasury securities with remaining maturities of six years to 30 years and to sell an equal amount of Treasury securities with remaining maturities of three years or less." On 6/20/2012 the FOMC "decided to continue throughout the end of the year its program to extend the average

			maturities of three years or less.”
U.S.	12/12/12	LSAP3	The FOMC announced that in addition to its existing MBS purchase program, it would purchase longer-term Treasury securities initially at a pace of US\$45 billion per month. Open ended.
<b>Country</b>	<b>Date</b>	<b>Program</b>	<b>Description</b>
U.K.	3/5/2009	APP1	The MPC announces it will purchase £75 billion of assets over three months. Conventional bonds likely to constitute the majority of purchases, restricted to bonds with residual maturity between five and 25 years. Facility expanded to £125 billion on 5/7/2009, to £175 billion on 8/6/2009 (and to bonds with residual maturity of three+ years), and to £200 billion on 11/05/2009. Previously, on 1/19/2009 the chancellor of the Exchequer announced that the BOE would set up an asset purchase program. On 1/30/2009 the Asset Purchase Facility was established.
U.K.	10/6/2011	APP2	The MPC announces it will expand asset purchases by £75 billion. An additional expansion by £50 billion is announced on 02/09/2012, and a further expansion by £50 billion on 7/05/2012.
Japan	10/5/2010	CME	Announcement of purchases of Japanese government bonds (JGBs), commercial paper, corporate bonds, exchange traded funds (ETF), Japanese real estate investment trusts (J-REITS). Total purchases planned by end 2013: JPY 76 trillion. Expanded several times /2.*
Japan	4/4/2013	QQME	Announcement of purchases of JGBs, ETFs and J-REITs with the goal of increasing the monetary base by JPY 60 to JPY 70 trillion annually, increasing the average maturity of JGBs held from three to seven years and meeting the 2 percent inflation target in about two years. *
<b>Targeted Liquidity Provision and Private Asset Purchases</b>			
U.S.	11/25/2008	LSAP1	The Federal Reserve will purchase up to US\$100 billion in agency debt and up to US\$500 billion in MBS. The Fed announces the creation of the TALF. The FOMC expands the program on 3/18/2009 announcing it will purchase US\$750 billion in MBS and US\$100 billion in agency debt over the next six months. On 9/23/2009 the FOMC decided to “gradually slow the pace” of MBS purchases and removed “up to” language with reference to MBS purchases limit. On 11/4/2009 the FOMC announces it “will purchase...about US\$175 billion of agency debt” and removed “up to” language with reference to agency debt limit.
U.S.	9/13/2012	LSAP3	The FOMC will purchase US\$40 billion MBS a month - open-ended.* Chairman Bernanke had expressed the intention on 8/31/2012.
U.K.	7/12/2012	FLS	FLS is announced. Banks and building societies that increase lending to U.K. households and businesses will be able to borrow more in the FLS, and do so at lower cost than those that scale back lending.
Japan	5/21/2010		Introduction of the fund-provisioning measure to support strengthening the foundations for economic growth (loan support program).



Japan	10/5/2010	CME	Announcement of purchases of Japanese government bonds, commercial paper, corporate bonds, exchange traded funds (ETF), Japanese real estate investment trusts (J-REITS). Total purchases planned by end 2013: JPY 76 trillion. Expanded several times /2.*
Japan	10/30/2012		Introduction of fund-provisioning measure to stimulate bank lending.
Japan	4/4/2013	QQME	Announcement of purchases of JGBs, ETFs and J-REITs with the goal of increasing the monetary base by JPY 60 to JPY 70 trillion annually, increasing the average maturity of JGBs held from three to seven years and meeting the 2 percent inflation target in about two years. *
Euro Area	8/9/2007		ECB provides liquidity to permit orderly functioning of the money market. From August 9–14 it injects €335 billion into the euro area banking system
Euro Area	12/12/2007	FX swaps	ECB takes joint action with the Federal Reserve by offering U.S. dollar funding to eurosystem counterparties. Extended several times on future dates.
Euro Area	5/9/2010	SMP	Securities Market Program (SMP) launched to ensure depth and liquidity in dysfunctional market segments (sovereign paper).
Country	Date	Program	Description
Euro Area	12/20/2011 2/28/2012	LTRO	ECB announced two three-year LTROs, reduced the reserve ratio from two percent to one percent and expanded collateral availability (additional performing claims-NCB discretion)
Euro Area	9/6/2012	OMT	Technical features of OMT. "A necessary condition for OMT transactions is strict and effective conditionality attached to an appropriate European Financial Stability Facility/European Stability Mechanism (EFSF/ESM) program." Mario Draghi expressed intention on 7/26/2012. The ECB first announced OMT on 8/2/2012.
<p>Source: Country authorities.</p> <p>Note: * Event is included in multiple entries.</p> <p>1/ Announcing an inflation target is more than just committing to temporarily loose policy in the future, instead it provides information about a permanent change in monetary policy.</p> <p>2/ Dates include 3/14/2011, 8/4/2011, 10/27/2011, 2/14/2012, 4/27/2012, 7/12/2012, 9/19/2012, 10/30/2012, and 12/20/2012, 1/22/2013.</p>			

**Appendix Table 2. Summary of Empirical Studies on the Bond Yield Effects of Unconventional Monetary Policies**

Effects Statistically Significant	Magnitude 1/ 2/	Main Channels	Events	Method	Authors
<b>U.S. LSAP1</b>					
Yes	50–100 bps (10-yr )	Portfolio Rebalancing	LSAP1 (eight events) 2/	Model-based Event Study (1-day window)	Gagnon et al (2011)
Yes	22–48 bps (10-yr)	Portfolio Rebalancing		Regression Analysis	
Yes	20 bps (10-yr)	Signaling little importance Prepayment Risk Channel	LSAP1 (five events)	Event Study (2-day window)	Krishnamurthy and Vissing-Jorgensen (2012)
Yes	42–147 bps (MBS or agency debt) 199 bps (MBS or agency debt) cumulative				
Yes	37 bps (10-yr) 94 bps cumulative	Signaling	LSAP1 (eight events)	Model-based Event Study (2-day window)	Bauer and Rudebusch (2011)
	56 bps (10-yr)	Portfolio Rebalancing			
Yes	53 bps (10-yr) 89 bps cumulative	Signaling	LSAP1 (eight events)	Model-based Event Study (2-day window)	Christensen and Rudebusch (2012)
Yes	29 bps (10-yr)	Portfolio Rebalancing			
Yes	32 bps (10-yr)		LSAP1 and LSAP2	Model-based (weekly data)	Hamilton and Wu (2011)
<b>U.S. LSAP2</b>					
Yes	8–10 bps (10-yr) 16–20 bps cumulative	Signaling	LSAP2 (three events) Jan 1990– Jan 2011	Event Study	Krishnamurthy and Vissing-Jorgensen (2012)
Yes	A fall in 10-yr yields of 8–10 bps	Safety Channel			

Effects Statistically Significant	Magnitude 1/ 2/	Main Channels	Events	Method	Authors
<b>U.K. APP1</b>					
Yes	90 bps (Gilt–OIS spread) 100 bps(Gilt )	Portfolio Rebalancing	APP1 (six events)	Event Study	Joyce et al (2011)
Yes	80 bps (Gilt–OIS spread) 125 bps(Gilt )	Portfolio Rebalancing		Surprise Calibration	
<b>JAPAN (2001–06)</b>					
Yes	0-50 bps (3–5 years)	Forward Guidance		Survey of several studies	Ugai (2007)
Partial	Mixed	Signaling			
Partial	Mixed	portfolio rebalancing			
No	Miniscule	Forward Guidance		Event Study and simulations	Bernanke et al (2004)
No	5bps	Signaling			
No	Miniscule		ABS	Event Study	Ueda (2012)
<b>JAPAN CME (2010–ongoing)</b>					
Yes	10 bps (JGB) 3 percent (equity) 3/		CME	Event Study	Lam (2011)
Partial	10 bps (JGB) 3 percent (equity) Miniscule on other assets		CME	Event Study	Ueda (2012)
Sources: Bernanke et al (2004), Gagnon et al (2011), Krishnamurthy and Vissing-Jorgensen (2012), Bauer and Rudebusch (2011), Christensen and Rudebusch (2012), Hamilton and Wu (2011), Joyce et al (2011), Lam (2011), Ueda (2012), and Ugai (2007).					
Notes:					
1/ This column describe the cumulative effect on the 10-yr Treasury yield due to the corresponding main channels.					
2/ LSAP1 (11/25/08, 12/01/12, 12/16/08, 01/28/09, and 03/18/09) and (08/12/2009, 08/12/09. and 11/04/09)					
3/ Most effects at introduction of CME (October 5, 2010).					

Appendix Table 3. Summary of Empirical Studies on the Macro Effects of Unconventional Monetary Policies

Authors	Sample Period/Frequency	Methodology	Identification	Size of the Shock	Main Findings (Peak Effect)	Effective Periods
<b>U.S.</b>						
Baumeister and Benati (2010) 1/	1965Q4-2009Q4 Quarterly	TVP SVAR	Sign/exclusion restrictions	100 bps negative shock to the 10-year Treasury bond yield spread	GDP growth increases by 2.4 percentage points Inflation increases by 1.6 percentage points	3 quarters 3/ 16 quarters 3/
		TVP VAR Counterfactual		Counterfactual inflation and GDP growth are calculated by eliminating the impact on the spread of the Fed's asset purchases programs has been equal to 100 bps. 7/	GDP growth increases by 6.7 percent points	2 quarters
Fuhrer and Olivei (2011)	1987Q1-2007Q4 Quarterly	SVAR	Cholesky	100 bps (persistent) negative shock to the 10-year Treasury bond yield	Inflation increases by 1.7 percentage points	> 4 quarters
		Federal Reserve Bank of Boston Model		100 bps (persistent) negative shock to the 10-year Treasury bond yield	GDP increases by 2.6 percent	> 8 quarters
Chen et al. (2012)		DSGE model with segmented asset market		A US\$600bn reduction of long-term debt in the hands of private sector (as in U.S. LSAP II) and the central bank to hold the interest rate at the ZLB for four quarters. 6/	GDP growth increases 0.13 percentage points	8 quarters 1/
					Inflation increases by 0.03 percentage points	> 20 quarters 1/
Chung et al. (2011)		Fed FRB/US macro model		Fed purchases of US\$2.6 trillion of long term securities (equivalent to a 80 bps reduction in term premiums).	GDP increases by 2.4 - 3 percent	> 6 years 1/
					Inflation increases by 0.4 - 1.0 percentage points	6 years 1/
Staff 7/	1994Q1-2012Q2 Quarterly	SVAR	Sign/exclusion restrictions	100 bps negative shock to the 10-year Treasury bond yield spread	GDP growth increases by 3.1 percentage points Inflation increases by 1.5 percentage points	2 quarters 9 quarters
<b>U.K.</b>						
Baumeister and Benati (2010) 1/	1965Q4-2009Q4 Quarterly	TVP SVAR	Sign/exclusion restrictions	100 bps negative shock to the 10-year Treasury bond yield spread	GDP growth increases by 2.4 percentage points Inflation increases by 1.8 percentage points	4 quarters 3/ 3 quarters 3/
		TVP VAR Counterfactual		Counterfactual inflation and GDP growth are calculated by eliminating the impact on the spread of the BOE's asset purchases programs has been equal to 100 bps 7/	GDP growth increases by 8 percentage points	> 4 quarters
Bridges and Thomas (2012) 1/	1964Q1-2007Q3 Quarterly	Money accounting/SVAR	Short/Long run restrictions	£122 billion (8 percent of the money stock) of increasing in money supply.	GDP increases by 1.5-2 percent	> 6 years
	1993M4-2010M9 Monthly	Bayesian VAR Counterfactual		Counterfactual inflation and GDP growth are calculated by eliminating the impact on the spread of the BOE's asset purchases programs has been equal to 100 bps.	Inflation increases by 1-2 percentage points	> 6 years
Kapetanios et al. (2012)	1993M4-2010M9 Monthly	Markov-switching SVAR Counterfactual		Counterfactual inflation and GDP growth are calculated by eliminating the impact on the spread of the BOE's asset purchases programs has been equal to 100 bps.	GDP growth increases by 0.28-0.72 percentage	> 12 months 1/
					Inflation increases by 1.03-1.07 percentage points	14 months 1/
	1963M2-2011M3 Monthly	Markov-switching SVAR	Sign/exclusion restrictions	100 bps negative shock to the 10-year Treasury bond yield spread	GDP growth increases by 2.75-5.13 percentage	> 9 months 1/
					Inflation increases by 1.31-3.38 percentage points	> 19 months 1/ 40 months 3/
Pesaran and Smith (2012) 1/	1968Q1-2011Q3 Quarterly	TVP VAR Counterfactual		Counterfactual inflation and GDP growth is calculated by eliminating the impact on the spread of the BOE's asset purchases programs has been equal to 100 bps	GDP growth increases by 1.5 percentage points 1/ 2/	> 50 months 3/
	1980Q3-2008Q4 (2011Q2) Quarterly	General autoregressive distributed lag (ARDL) model Counterfactual		Counterfactual GDP growth is calculated by eliminating the impact on the spread of the BOE's asset purchases programs has been equal to 100 bps.	GDP growth increases by 0.86-5.36 percentage	> 19 months 1/
Staff 7/	1994Q1-2012Q2 Quarterly	SVAR	Sign/exclusion restrictions	100 bps negative shock to the 10-year Treasury bond yield spread	Inflation increases by 1.30-3.63 percentage points	> 18 months 1/
					GDP growth increases by 0.75-1 percentage points	9-12 months
					GDP growth increases by 3.7 percentage points Inflation increases by 1.4 percentage points	2 quarters 6 quarters

Appendix Table 3 (cont'd)

Authors	Sample Period/Frequency	Methodology	Identification	Size of the Shock	Main Findings (Peak Effect)	Effective Periods
<b>Euro area</b>						
Baumeister and Benati (2010) 1/	1981Q1-2009Q3 Quarterly	TVP SVAR	Sign/exclusion	100 bps negative shock to the 10-year Treasury bond yield spread	GDP growth increases by 1 percentage points Inflation increases by 0.8 percentage points	1 quarters 3/ 3 quarters 3/
Lenza et al. (2010) 1/	1991M1-2007M12 Monthly	Bayesian VAR Counterfactual		Counterfactual inflation and industrial production are calculated by assuming that the spreads between money market rates and the	IP growth increases by 1.5-2.5 percentage points Inflation increases by 0.1-0.2 percentage points	36 months 6 months
Giannone et al. (2012) 1/	1999M1-2011M4 Monthly	Bayesian VAR Counterfactual		Counterfactual IP is calculated by predicting the level of central bank intermediation between August 2007 and April 2011 without policy intervention.	IP increases by 2 percent	> 36 months
Peersman (2011) 1/	1999M9-2009M12 Monthly	SVAR	Sign/exclusion	8 percent increase in the monetary base.	IP and CPI price level both increases, UMP shock	24 months 3/ > 30 months 3/
<b>Japan</b>						
Baumeister and Benati (2010) 1/	1976Q1-2009Q4 Quarterly	TVP SVAR	Sign/exclusion	100 bps negative shock to the 10-year Treasury bond yield spread.	GDP growth increases by 1.1 percentage points Inflation increases by 0.8 percentage points	2 quarters 3/ 2 quarters 3/
Fujiwara (2006) 1/	1985M1-2003M12	Markov-switching SVAR	Cholesky	An increase in monetary base and zero interest rate.	Regime one until 1998: IP increases by 0.8 percent Inflation increases by 0.25 pp Regime two after 1998: IP increases by 0 percent Inflation increases by 0 pp	30 months > 40 months
					Regime one until 2000: IP increases by 0.38 percent Inflation increases by 0 pp Regime two after 2000: IP increases by 0 percent Inflation increases by 0 pp	
Kamada and Sugo (2006) 1/	1978M2-1995M12 Monthly 1978M2-1999M1 Monthly 1978M2-2001M2 Monthly 1978M2-2005M4 Monthly	SVAR	Sign restrictions	The change in the policy stance is identified by using private banks'	IP increases by 0.35 percent CPI increase by 0.28 percentage points IP increases by 0.11 percent CPI increase by 0.21 percentage points IP increases by 0.09 percent CPI increase by 0.2 percentage points IP increases by 0.05 percent CPI increase by 0.16 percentage points	> 5 years 5/ > 5 years 5/ > 5 years 5/ > 5 years 5/ > 5 years 5/ > 5 years 5/ > 5 years 5/
Kimura et al. (2003) 1/	1980Q1-2002Q1	TVP SVAR	Cholesky	The growth rate of monetary base increases by 5pp.	1985Q2: Output gap increases by >0 1985Q2 Inflation increases by 0.4 percentage points 2002Q1: Output gap increases by 0 1982Q1 Inflation increases by 0	> 16 quarters 4/

Source: Authors.

Note: TVP VAR denotes time-varying parameter VAR.

For a related analysis based on identifying shocks to the size of central bank balance sheets, and not to levels of interest rates as in the above papers, see Gambacorta and others (2012).

1/ The paper provides only graphs for the effects of QE. Number presented here are based on the reading of these graphs.

2/ These numbers are taken based on the reading of the IRFs for Regime 4.

3/ This number is taken based on treating the 84th and 16th percentile of the impulse responses as the confidence intervals.

4/ This number is taken based on reading the impulse response function, as the confidence bands are not reported.

5/ This number is taken based on reading the medium impulse responses, as either 16th nor 84th percent quantiles are reported.

6/ Note 10-year yield is an endogenous variable in the model

7/ To make the results comparable, we translate the impacts into the equivalent of a 100 bps shock to the spread.

8/ Median effect from a range of estimates calculated base on a rolling sample with a fixed window.

**Appendix Table 4. Regression Results***Response to a Monetary Policy Easing*

Country:	U.S.		U.K.		JP /1	
Period:	Pre	Post	Pre	Post	Pre	CME
<b>Fixed Income</b>						
Gov Bond Yield 2-yr	↓	↓	↓	↓	↓	↓
Gov Bond Yield 10-yr	↓	↓↓	↓	↓	↓	↓
MBS Yield 15-yr	↓	↓				
Agency Yield 10-yr	↓	↓↓				
BBB-AAA Corp Spread	n.s.	↑		n.s.	↑	n.s.
<b>Tail Risk</b>						
PC: FX Risk Reversal /2	n.s.	↓	↓	↓	n.s.	n.s.

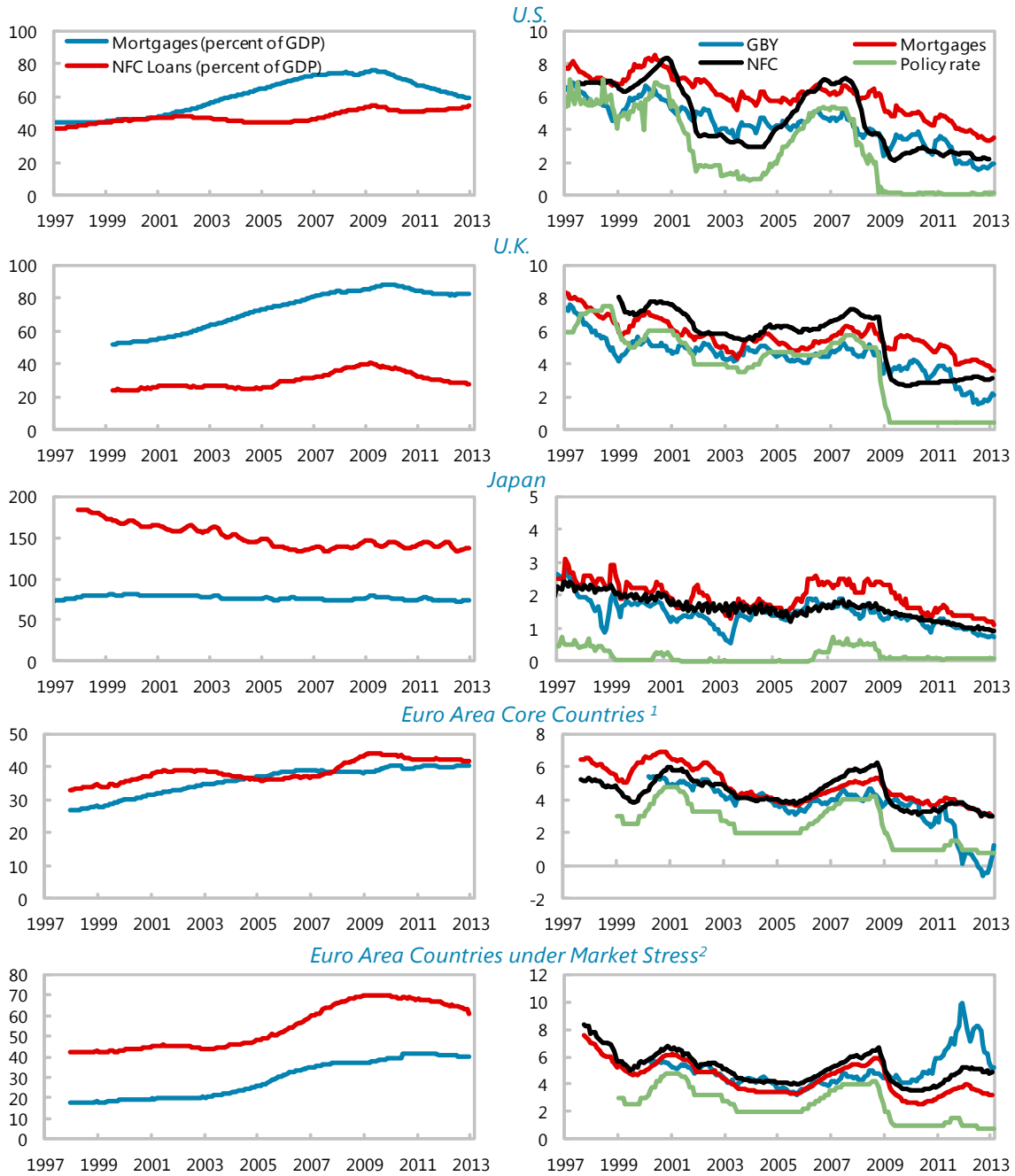
Source: IMF staff estimates.

Note: Arrows indicate statistically significant effects and two arrows indicate statistically greater effects. Pre is defined as 1/3/2000–7/8/2007 and Post starts on the first announcement of bond purchases.

/1 In Japan the Pre period refers to past asset purchase programs between 2001 and 2006, while the CME period refers to Comprehensive Monetary Easing. The QQME announcement was not included since a meaningful measure of surprise could not be extracted from the near-zero one year ahead futures on Libor.

/2 The principle component was used to extract a single series from the FX risk reversals between Japan, U.K., euro area, and U.S. A two-day window is used for the Risk Reversals to account for different time zones.

**Figure 5. Credit Growth and Interest Rate Transmission**  
(In percent of GDP and percentage)



Sources: Haver Analytics; National Central Banks; Thomson Reuters Datastream; and staff computations.

Notes: GBY: government bond yield; NFC: non-financial corporations. Series for euro area core countries and countries under market stress are volume weighted. <sup>1</sup>Core series are obtained as the euro area aggregate minus those from countries under market stress. <sup>2</sup>Euro area countries under market stress include Spain, Italy, Greece, Portugal and Ireland.

### Box 3. Spillovers of the Great Depression: A View from Latin America

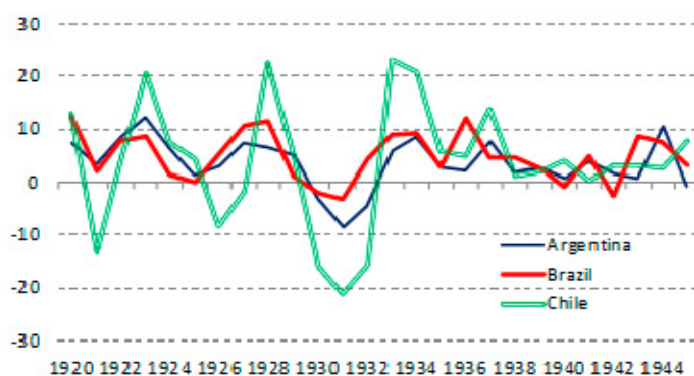
The Great Depression quickly spread to the rest of the world. As the U.S. economy contracted, the Fed's monetary policy failed to act countercyclically. As a result, money supply declined and real interest rates surged. Contagion to the rest of the world was thus inevitable, leading to a worldwide economic depression.

Contagion took place through three main channels: trade flows, commodity prices, and capital outflows. Small open economies suffered most from the decline in trade. In Chile, for instance, exports fell about 30 percent on average during 1930–32. Weak demand also pushed commodity prices downward, including oil (more than 30 percent), copper (almost 70 percent), and wheat (about 65 percent) from 1929 to 1932. In addition, there was a reversal of capital inflows, previously the main source fiscal financing, just as fiscal revenues collapsed.

Despite countercyclical policies adopted by their central banks, the Great Depression took a high toll on Latin American economies. Central banks initially cut interest rates (Colombia, Chile, and Ecuador halved the discount rate).<sup>1/</sup> Countries then abandoned the gold standard, which gave monetary policy more room for maneuver, allowing central banks to implement credit and quantitative easing.<sup>2/</sup> Central banks also financed government deficits in order to compensate the total absence of external funding. Yet, output declined significantly, especially in 1931 and 1932 as shown in Figure 6. In addition, the consumer price index dropped significantly (by more than 10 percent per year in Argentina and Brazil in the early 1930s)<sup>3/ 4/</sup> while real salaries in Chile did not recover until 1943.<sup>5/</sup>

**Figure 6. GDP Growth in Latin America  
1920–45**

(Selected countries, annual percentage change)



Sources: 1/ Tamagna (1963); 2/ Jacome (2013, forthcoming); 3/ *Ambito Financiero*; 4/ Haddad (1978); and 5/ Diaz and others (2010).