CHAPTER 3

DO CENTRAL BANK POLICIES SINCE THE CRISIS CARRY RISKS TO FINANCIAL STABILITY?

Summary

Major central banks have taken unprecedented policy actions following the financial crisis. In addition to keeping interest rates low for a prolonged period, they have taken a host of unconventional measures, including long-term liquidity provision to banks in support of lending, as well as asset purchases to lower long-term interest rates and to stabilize specific markets, such as those for mortgages.

Although the objectives differ somewhat across central banks, these policies have generally aimed to support the macroeconomy (by avoiding deflation and depression) and address short-term financial stability risks. Using econometric and other evidence, this chapter finds that the interest rate and unconventional policies conducted by the central banks of four major regions (the euro area, Japan, the United Kingdom, and the United States) appear indeed to have lessened vulnerabilities in the domestic banking sector and contributed to financial stability in the short term. The prolonged period of low interest rates and central bank asset purchases has improved some indicators of bank soundness. Central bank intervention mitigated dysfunction in targeted markets, and large-scale purchases of government bonds have in general not harmed market liquidity. Policymakers should be alert to the possibility, however, that financial stability risks may be shifting to other parts of the financial system, such as shadow banks, pension funds, and insurance companies. The central bank policy actions also carry the risk that their effects will spill over to other economies.

Despite their positive short-term effects for banks, these central bank policies are associated with financial risks that are likely to increase the longer the policies are maintained. The current environment shows signs of delaying balance sheet repair in banks and could raise credit risk over the medium term. Markets may be alert to these medium-term risks, as central bank policy announcements have been associated with declines in some bank stocks and increases in yield spreads between bank bonds and government bonds. Central banks also face challenges in eventually exiting markets in which they have intervened heavily, including the interbank market; policy missteps during an exit could affect participants' expectations and market functioning, possibly leading to sharp price changes.

Even though monetary policies should remain very accommodative until the recovery is well established, policymakers need to exercise vigilant supervision to assess the existence of potential and emerging financial stability threats, and they should use targeted micro- and macroprudential policies where possible to mitigate such threats to allow greater leeway for monetary policy to support the macroeconomy. Macroprudential policies—which may include robust capital standards; improved liquidity requirements; and well-designed, dynamic, forward-looking provisioning—should be implemented in a measured manner, as needed. The crisis has shown that corrective policies enacted after the risks materialize may be too late to contain damage to financial stability. As the experience with some macroprudential policies is relatively limited, their effectiveness should be carefully monitored. In the meantime, the unconventional monetary policy actions should continue, as they have, to keep financial stability goals in mind.

The central banks of the largest advanced economies have taken unprecedented measures to combat the deepest and most prolonged period of recession and financial instability since the 1930s. These measures include an extended period of very low interest rates as well as so-called unconventional policies—providing long-term liquidity to banks to support the flow of credit, lowering long-term rates through bond purchases, and stabilizing specific markets such as mortgage lending.[1] Central banks have also issued "forward guidance," in which they announce an intention to maintain an accommodative stance for an extended period. We will refer to the combination of exceptionally low policy interest rates and unconventional policy measures as "MP-plus" to indicate that these policies go beyond conventional monetary policy in terms of tools and objectives.

The objectives of MP-plus are to benefit not only the macroeconomy but also financial stability. By providing liquidity to banks and buying specific assets, MP-plus directly mitigates short-term instability in financial markets and vulnerabilities in the domestic banking sector. In addition, MP-plus also indirectly limits stress in the financial sector to the extent that it succeeds in preventing a sharper economic downturn. By encouraging economic activity through its easing of credit conditions, MP-plus can help strengthen private and public balance sheets and thus make a more durable contribution to financial stability. Such benefits may result, for instance, if firms take advantage of lower longer-term rates by extending the maturity profile of their debt.

However, MP-plus may have undesirable side effects, including some that may put financial stability at risk. Ample bank liquidity may raise credit risk at banks by compromising underwriting and loan quality standards, and it may encourage a delay in necessary balance sheet repair and bank restructuring. Likewise, low interest rates encourage other financial institutions, including pension funds, insurance companies, and money market mutual funds, to increase risk by "searching for yield." A search for yield can help push the market value of some assets beyond their fundamental value ("bubbles") or drive an excessive increase in balance sheet leverage. In some cases, risks may stem not from the unconventional policies themselves but from the difficulties in exiting from them. Where central banks intervened in markets to mitigate instability, their presence may affect market functioning or mask continuing vulnerabilities, complicating exit and raising the potential for policy missteps.

This chapter aims to bring empirical evidence to bear on some of the financial stability effects of MP-plus. It defines and quantifies the MP-plus policies of four major central banks—the Federal Reserve, the European Central Bank (ECB), the Bank of Japan (BOJ), and the Bank of England (BOE)—and then identifies possible risks to domestic financial stability and to the financial health of banks. Banks are the focal point of the chapter because they are naturally leveraged and, as a whole, they are the most systemically important financial institutions in the advanced economies that are actively using MP-plus policies. The potential effects on pension funds and insurance companies and evidence of emergent bubbles are covered in Chapter 1. The risk that central bank measures will have macroeconomic and financial stability effects abroad is an important topic that deserves careful analysis; to keep the scope of this chapter manageable, it is not covered here, but it is examined in Chapter 1 and in an IMF paper on unconventional monetary policy (IMF, forthcoming).[2]

In the areas it examines, the chapter finds few immediate financial stability concerns associated with MP-plus. So far, it appears to have increased some measures of bank soundness; and in markets where central banks have become major players, their intervention either has not appreciably affected market liquidity or it has corrected market dysfunction. However, the longer

Note: This chapter was written by S. Erik Oppers (team leader), Ken Chikada, Frederic Lambert, Tommaso Mancini-Griffoli, Kenichi Ueda, and Nico Valckx. Research support was provided by Oksana Khadarina.

[1]Examples of the unconventional policies are quantitative easing by the Federal Reserve, the Funding for Lending Scheme by the Bank of England, and the announcement of the Outright Monetary Transactions of the European Central Bank. The Bank of Japan implemented a program of quantitative easing in the early 2000s and—along with other unconventional policy measures—again in the aftermath of the global financial crisis.

[2]Also see previous IMF publications for the effect on pensions and insurance (for example, Chapter 2 of the September 2011 GFSR) and spillovers (Chapter 4 of the April 2010 GFSR).

that MP-plus policies remain in place, a number of potential future risks are likely to increase, including heightened credit risk for banks, delays in balance sheet repair, difficulties in restarting private interbank funding markets, and challenges in exiting from markets in which central banks have intervened. The markets may be alert to these medium-term risks, since the analysis finds evidence of an increase in the medium-term risk of bank default after MP-plus announcements.

Policymakers should use micro- and macroprudential policies where possible to counter the financial stability risks that may be emerging over the medium term. Implementing such policies in a measured manner, as needed, would allow MP-plus greater leeway to support price stability and growth while protecting medium-term financial stability. However, the exceptional nature of current monetary policies and the relatively untested macroprudential tools in many countries make this uncharted territory for policymakers, and the effectiveness of the policy mix should be carefully monitored.

With a focus on financial stability, the chapter will not address the timing or modalities of the exit from MP-plus, although Box 3.1 notes some financial stability risks that may arise with exit. The chapter will also not assess the current and future economic effectiveness of unconventional monetary policies. These topics are covered in IMF (2010a) and IMF (forthcoming) respectively.

MP-Plus: An Overview

After the start of the financial crisis in 2007, central banks in major advanced economies undertook a number of MP-plus measures.[3] These measures can be classified into four groups (with some overlap between groups):

- *Prolonged periods of very low interest rates,* sometimes combined with forward guidance on the length of time for which rates are expected to remain low;
- *Quantitative easing* (QE), which involves direct purchases in government bond markets to reduce yield levels or term spreads when the policy rate is at or close to the lower bound;
- *Indirect credit easing* (ICE), in which central banks provide long-term liquidity to banks (sometimes with a relaxation in access conditions), with the objective of promoting bank lending; and
- *Direct credit easing* (DCE), when central banks directly intervene in credit markets—such as through purchases of corporate bonds or mortgage-backed securities—to lower interest rates and ease financing conditions (and possibly mitigate dysfunction) in these markets.

MP-plus measures were taken with both macroeconomic and financial stability objectives in mind, with the mix depending, in part, on the mandates of specific central banks. The financial stability objectives are the subject of this chapter. Box 3.2 summarizes IMF (forthcoming), which looks at the macroeconomic effects of unconventional monetary policies.

These operations have led to a fundamental change in the size and composition of central bank balance sheets. Total assets have increased significantly, mostly in the form of government securities, bank loans, equities, and mortgage-backed securities (Table 3.1 and Figure 3.1). These shifts entailed specific (and new) risks for central banks, including credit and market risks. Unless they are adequately managed, including through enhanced loss-absorbing capacity, these risks (or perceptions about them) may affect the ability of central banks to perform their mandated roles and their credibility. If balance sheet assets are managed poorly, they could affect financial stability, as discussed later in this chapter.

Outlined below are some risks that are, or might become, associated with MP-plus—not all of them are currently evident—along with recommendations for corresponding policy responses. The next sections will examine the extent to which some of these risks are emerging today—in specific financial markets as well as in financial institutions—and which of them may become more pronounced over the medium term. The descriptions below are meant to provide the full scope of potential channels through which financial stability could be affected—some of these channels are examined below, others in Chapter 1. These effects focus on domestic institutions and markets; as noted above, other IMF publications address the important potential spillovers to other economies.

[3]Annex 3.1 lists the various announcements of MP-plus measures since the start of the financial crisis.

Table 3.1. Asset Holdings of Major Central Banks Related to MP-Plus, 2008–12

	Dec-08	Dec-09	Dec-10	Dec-11	Oct-12	Reasons
Bank of England (in billions of pounds)						
Liquidity (longer term)[1]	170	24	17	10	11	Provide adequate bank refinancing
Asset Purchase Facility						
Gilts	. . .	188	198	249	375	Raise nominal spending in order to meet inflation target by affecting level and shape of yield curve
Corporate bonds	. . .	1.55	1.12	0.65	0.03	Improve liquidity in corporate credit
Commercial paper	. . .	0.43	0.00	0.00	. . .	
Funding for lending	. . .	. . .	. . .	. . .	4.4[2]	Encourage lending to the real economy
Memorandum items: Total assets	238	238	247	290	414	
GDP	1,441	1,402	1,467	1,516	1,548	
Bank of Japan (in trillions of yen)						
Liquidity (new stimulus)	...	...	24.8	32.0	29.0	Ease financing conditions
Other outstanding loans and repo	39.9	42.3	18.8	7.5	3.7	
Asset purchases						
Commercial paper	...	...	0.1	2.0	1.5	Reduce market rates and risk premiums
Corporate bonds	...	...	0.1	1.5	2.9	across various types of financial assets
Government bonds and bills	...	...	1.2	5.6	28.4	and combat deflation risks
ETFs, REITs	...	...	0.02	0.9	1.6	
Memorandum items: Total assets	123	123	129	143	150	
Total sovereign holdings	63.1	72.0	76.7	90.2	107.6	
GDP	501	471	482	471	477	
European Central Bank (in billions of euros)						
Short-term liquidity	226	81	249	160	117	Maintain sufficient bank intermediation
Long-term liquidity	617	669	298	704	1059	and provide longer-term bank financing
Asset purchases						
Covered bonds (CBPP)	...	29	61	62	70	Sustain key bank funding channel
Government bonds (SMP)	...	...	75	213	208	Maintain/restore European Central Bank policy rate transmission
Memorandum items: Total assets	2,043	1,852	2,004	2,736	3,047	
GDP	9,242	8,922	9,176	9,421	9,503	
Federal Reserve (in billions of U.S. dollars)						
Short-term liquidity						
Loans and repo	274[3]	86	45	9	1.2	Provide adequate short-term bank funding
U.S. dollar swaps	554	10	0.08	100	12.5	Provide adequate funding for foreign exchange operations
Long-term liquidity						Provide adequate long-term bank funding
TALF	. . .	0.30	0.67	0.81	0.86	against MBS and ABS collateral
Asset purchases						
Agency MBS	. . .	908	992	837	852	Support housing finance
Agency debt	20	160	147	104	82	Support GSEs
Treasury securities	476	777	1016	1672	1651	Affect level and shape of yield curve
Memorandum items: Total assets	2,241	2,237	2,423	2,928	2,832	
GDP	14,292	13,974	14,499	15,076	15,653	

Sources: Central banks' websites; Haver Analytics; and IMF staff estimates.

Note: ABS = asset-backed securities; CBPP = Covered Bond Purchase Programme; ETFs = exchange traded funds; GSEs = government-sponsored enterprises; MBS = mortgage-backed securities; REITs = real estate investment trusts; SMP = Securities Market Programme; TALF = Term Asset-Backed Securities Loan Facility.

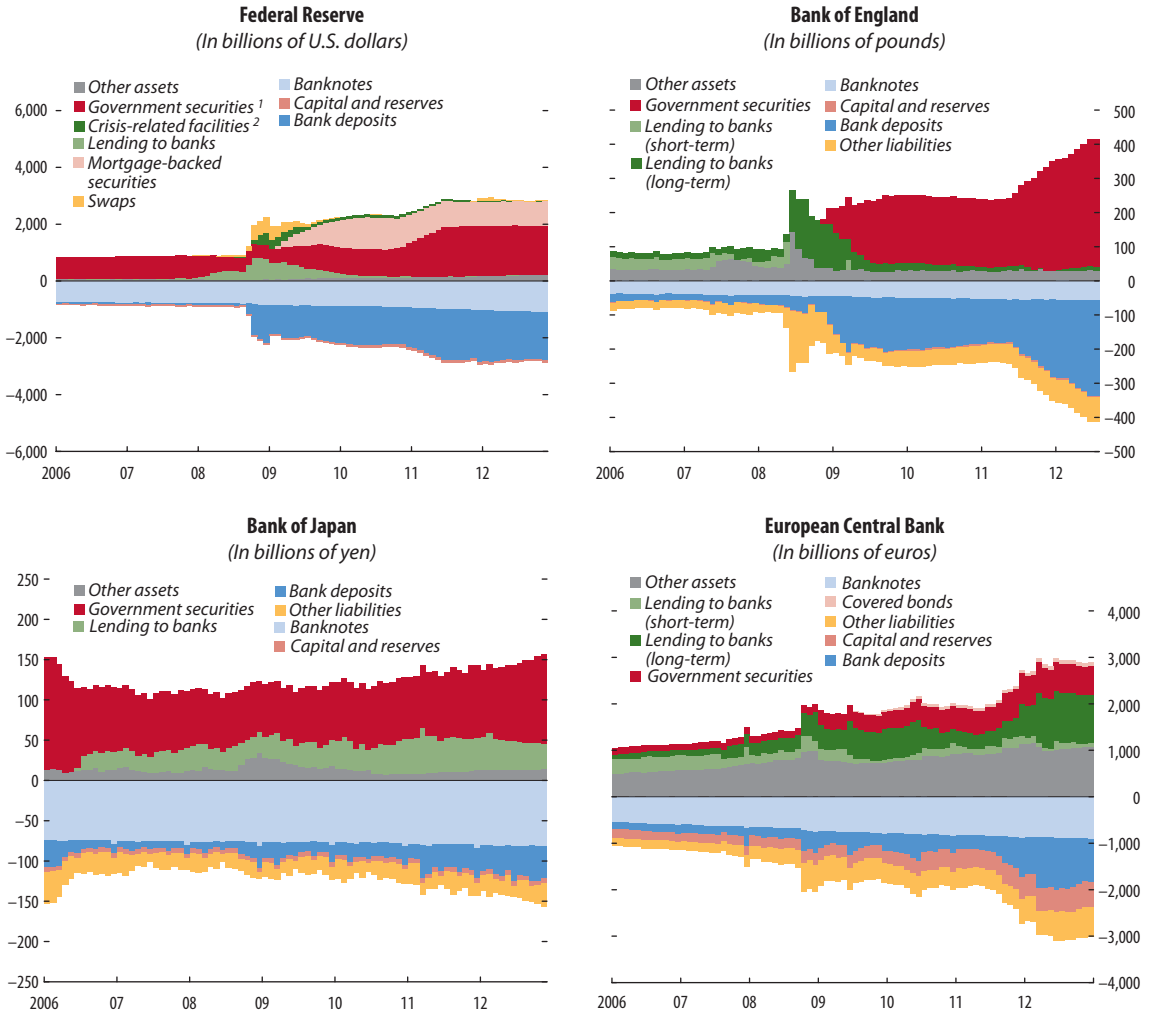
[1]Zero short-term liquidity provision over the sample period outstanding at end-December 2008.

[2]Includes use of Extended Collateral Term Repo and Long-Term Repos.

[3]Includes 28-day transactions under the TSLF (Treasury Securities Lending Facility) of about $190 billion.

- *Prolonged periods of low interest rates* can affect the profitability and solvency of financial institutions. A flattening of the yield curve puts pressure on banks' interest margins, and low interest rates increase the net present value of liabilities of pension funds and life insurance companies. Low-yielding assets may induce excessive risk taking in a search for yield, which may manifest itself in asset price bubbles. The low opportunity cost of funds and reduced net interest margins may also give banks incentives to delay the cleanup of their balance sheets and reduce pressure on authorities to demand vigorous bank restructuring. Low interest rates could also encourage pockets of excessive releveraging—in banks, which

Figure 3.1. Changes in Central Bank Balance Sheets, 2006–12



Sources: Haver Analytics; national central banks; and IMF staff estimates.

Note: Government bonds purchased under the Bank of England's quantitative easing (QE) program are held by a separate subsidiary, which is financed by loans from the Bank of England (under "other assets"). Reported here are the amounts purchased under the asset purchase facility (the corresponding loan amount is subtracted from "other assets").

[1]Including agency securities.

[2]Special purpose vehicles, commercial paper, and money-market-related assets.

are naturally leveraged, but also in the nonfinancial corporate or household sectors. Banks will require vigilant risk-based supervision, capital requirements should be adjusted to account for the true riskiness of loan portfolios and other assets, and well-designed dynamic and forward-looking provisioning should be implemented (see Wezel, Chan-Lau, and Columba, 2012).

- *Quantitative easing* could exacerbate shortages of safe assets (although the policy intention is, in part, to encourage investment in riskier, more productive assets).[4] As with indirect credit easing, the large increases in bank liquidity associated with QE could make financial institutions addicted to central bank financing (since central bank intermediation of interbank funds shifts

[4]The availability of safe assets could decline through increased central bank holdings (as a result of QE purchases) and through the increased encumbrance of assets, as banks post more collateral at central banks to obtain funding. The latter is encouraged as central banks relax collateral rules. See also Chapter 3 of the April 2012 GFSR.

Box 3.1. Financial Stability Risks Associated with Exit from MP-Plus Policies

In considering the risks to financial stability of exit from MP-plus, it is useful to distinguish between two aspects, namely, an exit from low policy rates and the sale of central banks' accumulated inventory of assets, most of which are debt securities.

In the current cycle, as in previous ones, the central bank will need to raise interest rates at some point to safeguard price stability. But the need to sell assets to tighten policy is less evident—central banks could simply hold them to maturity and use other policy tools; but other concerns, including political considerations, may still prompt asset sales. Hence, the challenges and risks of both types of exit must be anticipated and managed, especially since the use of MP-plus policies is uncharted territory for policymakers.[1]

The main financial stability risks of exit are associated with an unexpected or more-rapid-than-expected increase in interest rates, especially at the longer end of the yield curve. Hence, when the time comes to tighten financing conditions for banks and the economy, central banks would likely aim for an anticipated and gradual increase in interest rates, giving economic agents time to adjust. A disorderly increase or an overshooting—perhaps as a result of shifts in market sentiment—would make adjustment to the new financial environment much more difficult, heightening the risks listed below.

Many MP-plus policies are unprecedented, and they have now been in place for a relatively long time. It is therefore even more important than during a normal tightening cycle that exit strategies are well communicated to the general public as well as to markets, financial institutions, and other central banks. The risks below also underline the importance of efforts to ensure that bank soundness and market liquidity are restored as soon as possible to minimize the financial stability threats of a future exit from MP-plus.

Risks associated with increasing interest rates include the following:

- *Banks and other financial institutions may incur capital losses on fixed-rate securities.* While the evidence suggests that a rise in interest rates increases net interest margins for banks, improving their profitability over time, losses on fixed-rate securities available for sale are immediate. In the short term, therefore, weakly capitalized banks could suffer. For financial institutions with long-term liabilities, such as pension funds, capital losses may be offset by a decrease in the net present value of liabilities.
- *Credit risk for banks may increase.* Higher interest rates could weaken loan performance, especially if the rise is in response to an inflation threat rather than improved economic circumstances.
- *Spillovers to other countries or markets may occur.* Shifting expectations of the path of future interest rates can lead to financial flows between markets and countries that could be sudden and potentially disruptive, especially if the timing of tightening differs across central banks.

Risks associated with asset sales include the following:

- *Shifts in market sentiment may lead to sharp increases in yields.* Uncertainty about the necessity or willingness of central banks to sell their large portfolios of government bonds and other assets could lead to shifts in market sentiment when central bank asset sales materialize.
- *Policy missteps may disrupt markets.* If central banks sell assets before underlying market vulnerabilities are addressed, dysfunction could resurface. This risk is heightened in markets where central banks hold a large share of outstanding securities or played an important market-making role, especially if ongoing market dysfunction is now masked by central bank intervention.
- *Banks may face funding challenges.* Just as the counterpart of purchases of assets by central banks was an increase in banks' excess reserves, the counterpart of asset sales would likely be a decline in banks' excess reserves. This disintermediation of interbank liquidity by the central bank would have to be offset by a revival of private interbank markets. If this market is not fully restored, some banks could face funding challenges.

Note: Prepared by S. Erik Oppers and Nico Valckx.

[1]See IMF (2010a) for a description of the principles underlying exit strategies; IMF (forthcoming) presents some further thoughts on the topic.

Box 3.2. The Macroeconomic Effectiveness of MP-Plus

Central banks have deployed a variety of unconventional measures during the crisis. But is there a limit to their effectiveness in case of a potentially prolonged downturn?

A forthcoming IMF publication, "Unconventional Monetary Policies: Recent Experience and Prospects," 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 key advanced economies 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 of policy interest rates. 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 in 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. Some evidence also suggests that these policies encouraged growth and prevented deflation, although this conclusion is less clear-cut, given the long lags and unstable relationships between variables, and the unresolved question of what would have happened without central bank policy intervention.

Unconventional monetary policies had a mixed effect on the rest of the world. Early policy announcements buoyed asset prices globally, and likely benefited trade. Later announcements had smaller effects and increased capital flows to emerging market economies, 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 if they worsen. Yet, bond purchases in particular seem to exhibit diminishing effectiveness, and their growing scale raises risks. A key concern is that monetary policy is called on to do too much, and that needed fiscal, structural, and financial sector reforms are delayed.

Note: Prepared by Tommaso Mancini-Griffoli.

credit risk away from the private parties), delaying balance sheet repair and the restoration of an interbank market. Improved liquidity risk management in banks and implementation of Basel III liquidity requirements can help ease some of these risks (see Chapter 2 of the April 2011 GFSR).

- *Indirect credit easing* could make financial institutions dependent on long-term central bank (that is, public sector) financing, delaying the restoration of private sources of funding and providing incentives to allocate bank credit toward borrowers that qualify for the associated lending program. Some of these borrowers might not otherwise qualify for loans, thereby weakening underwriting standards, with potential adverse effects on longer-term loan performance and hence on the future health of banks. These risks to loan performance should be acknowledged by banks and their supervisors, and appropriate forward-looking provisions should be made.
- *Direct credit easing* could introduce distortions to prices and market functioning if central banks become the dominant buyer in markets in which they intervene. These distortions could emerge with rising expectations of an imminent central bank exit and could under certain circumstances lead to large price swings and other dysfunction. Banks may be hurt by these price swings if they hold large volumes of securities traded in these markets. Supervisors should be cognizant of these potential risks, which banks should be required to address.

Some of these risks are closely connected to the intended policy objectives. For example, although central bank intervention may distort market dynamics or functioning in a way that may have negative implications for financial stability, drawing investors (back) into intervened markets may in fact have been the intended goal of the policy. This highlights the care with which the potential threats to financial stability need to be evaluated.

Effects of MP-Plus on Markets

Money and Interbank Markets

The prolonged period of low interest rates increases risks in money markets, including through developments in money market mutual funds (MMMFs). With interest rates remaining near zero in the maturities at which MMMFs are permitted to invest, these institutions are experiencing very low (in some cases zero or negative) returns that in many cases fail to cover the costs of fund management. As a consequence, U.S. MMMFs have raised credit risk modestly (within the confines of regulatory restrictions), engaged in more overnight securities lending, granted fee waivers, and turned away new money.

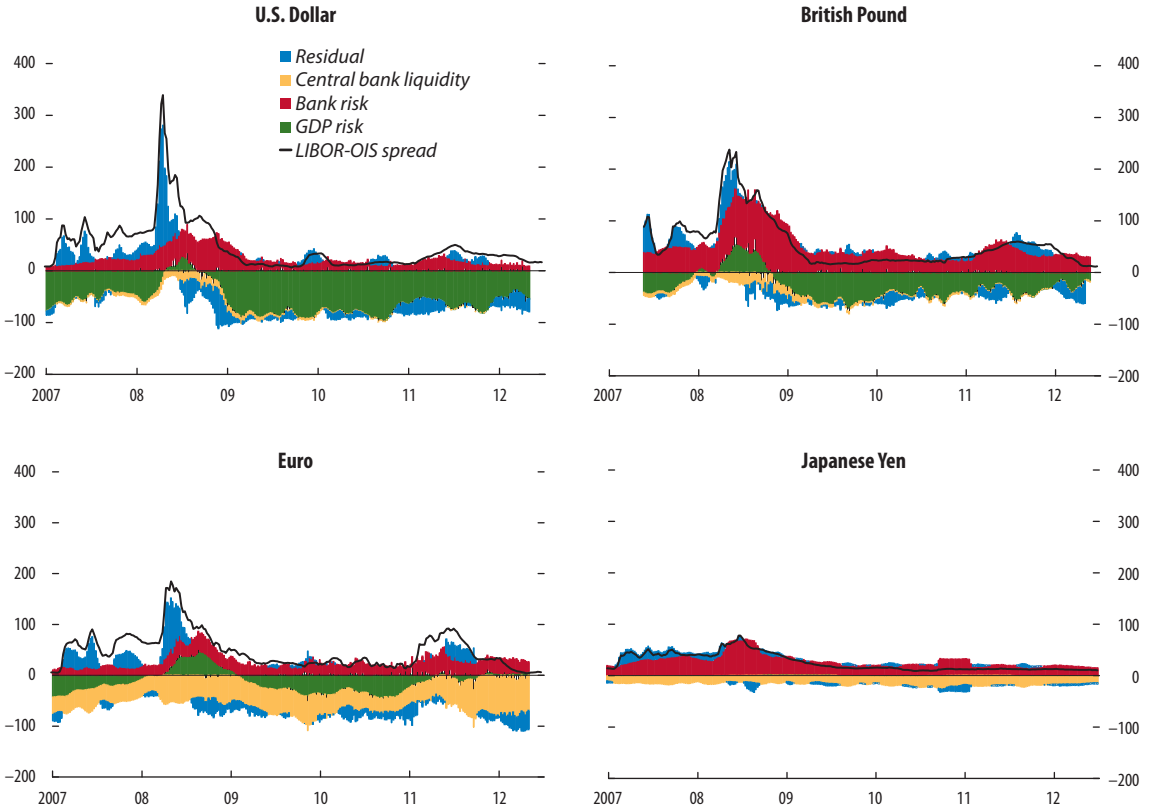
The fundamental problem is that to become profitable the MMMF industry needs to shrink further, and the risk is that it may do so in a disorderly fashion. For example, another run on MMMFs may occur if downside credit risks materialize or securities lending suddenly halts, fueling investors' fear of MMMFs "breaking the buck" (that is, failing to maintain the expected stable net asset value). Once started, a run may accelerate because investor guarantees that were established in the wake of the Lehman Brothers bankruptcy have been removed, and the Dodd-Frank Act precludes the Federal Reserve from unilaterally stepping in to provide liquidity to the sector.[5] Although the assets of MMMFs are already shrinking in the low interest rate environment as investors seek higher returns elsewhere, an outright run would be undesirable and could have systemic consequences if the funding that these institutions provide to banks—directly and through overnight securities lending—dries up.

Central bank interventions in the interbank markets were a response to a significant reduction in interbank lending activity that mostly resulted from increased sensitivity to counterparty risk. With indirect credit easing policies, central banks made longer-term funds available at fixed low rates and softened collateral rules, aiming to avoid a severe credit contraction. This form of credit easing lowered interbank spreads during the crisis, especially in the euro area and Japan. By partially replacing the interbank market, central banks play a crucial role in the distribution of bank funding in some areas.

From a money-market perspective, risks stem not so much from central bank intervention itself as from a misstep in the eventual withdrawal from the market. If central banks exit from interbank markets before underlying conditions are addressed and the private bank funding market is fully restored, renewed strains could resurface, with the costs of short-term bank financing turning significantly higher for some banks. These risks are difficult to quantify because central bank intervention may mask the dysfunction it was designed to address. A decomposition of interbank spreads may offer some insights (Figure 3.2). Central bank liquidity no longer appears to significantly affect interbank market spreads in the United States and the United Kingdom. This could indicate that future central bank exit from these markets would not affect interbank spreads there. In the euro area and Japan, however, central bank intervention ("Central bank liquidity" in Figure 3.2) appears to continue to mask more elevated interbank market spreads due to increased sensitivity to counterparty risk ("Bank risk" in Figure 3.2). This could be an indication that spreads could increase if and when central banks withdraw bank liquidity, although the gradual decline of such liquidity in Japan over the past year (see Figure 3.1) does not appear to have led to significantly increased yield spreads.

[5]The U.S. Treasury Department introduced the Temporary Guarantee Program, which covered certain investments in MMMFs that chose to participate in the program and has now expired. The Federal Reserve created an Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility, through which it extended credit to U.S. banks and bank holding companies to finance their purchases of high-quality asset-backed commercial paper from MMMFs.

Figure 3.2. OIS Counterparty Spread Decompositions
(Three-month LIBOR-OIS spread, in basis points)



Sources: Bloomberg L.P.; Datastream; JPMorgan Chase; and IMF staff estimates.

Note: CDS = credit default swaps; LIBOR = London interbank offered rate; OIS = overnight indexed swap; PMI = Purchasing Managers' Index. Decomposition based on least-squares regressions of weekly LIBOR-OIS spreads on a constant (not shown), indicators of growth risk (PMI-based GDP tracker), sovereign risk (changes in sovereign CDS spread; the Sovx Western Europe Index for the euro area; sovereign CDS spreads for the United Kingdom and the United States), bank risk (major bank equity index historic 90-day volatility), and central bank liquidity (liquidity provision to banks as a percent of banking sector assets). Higher growth, increased central bank liquidity, lower bank volatility, and sovereign risk all tend to reduce LIBOR-OIS spreads. The sovereign risk contribution is not shown, as it is very small relative to the other factors in the regression.

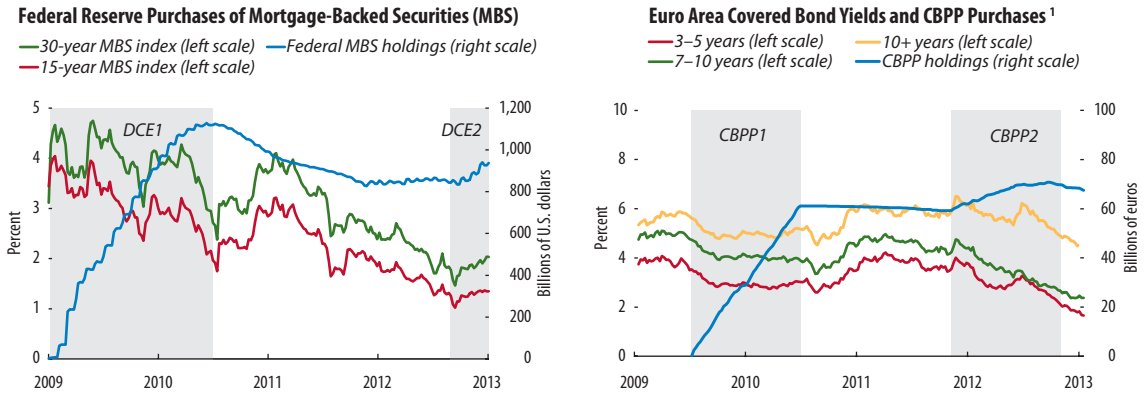
Mortgage and Corporate Securities Markets

Direct credit easing by the major central banks through interventions in mortgage and corporate bond markets have attempted to improve liquidity and lower interest rates for borrowers in these markets. During 2009 and the first half of 2010, the Federal Reserve purchased close to $1 trillion in mortgage-backed securities (MBS) to support the U.S. housing market and alleviate pressures on the balance sheets of U.S. banks. It made a new commitment to buy MBS in September 2012 in an effort to lower mortgage interest rates further and spur credit extension (Figure 3.3). In two purchase programs, the ECB bought a total nominal amount of €76.4 billion of covered bonds, and the BOE bought up to £1.5 billion in corporate bonds. The BOJ also maintains a limited program to purchase corporate bonds, real estate investment trusts (J-REITs), and exchange-traded funds (corporate stocks).

Some central banks have made extensive purchases in these markets. While geared toward clear objectives, these programs may mask continuing underlying distortions, and their removal may pose policy challenges. The programs of the Federal Reserve and ECB appear to have reduced yields as intended (see Figure 3.3; and IMF, forthcoming).[6] In particular, the purchases of the

[6]In addition, an analysis (not reported here) of Federal Reserve interventions in MBS markets and ECB interventions in euro area covered bond markets (controlling for other risk factors) confirms the significant effect on yields of these MP-plus policies.

Figure 3.3. Central Bank Intervention in Real Estate Securities Markets



Sources: European Central Bank; Federal Reserve; JPMorgan Chase; and IMF staff estimates.
Note: DCE = direct credit easing; CBPP = Covered Bond Purchase Programme. Shaded areas show different periods of DCE and CBPP purchases.
[1]Covered bond yields refer to euro area Pfandbriefe indices.

Federal Reserve have made it a major market player, holding 20 percent of outstanding MBS.[7] Central bank intervention in these markets does not in itself threaten financial stability (indeed, it was designed to safeguard it), but it does raise policy risk surrounding a future exit. While the presumption may be that central banks should not and would not exit before underlying conditions permit, the large current role of central banks may mask underlying vulnerabilities in the private market that may be difficult to assess. An inadvertently premature exit could have an adverse impact on market liquidity and prices if it turns out that underlying market conditions have not improved.

Government Bond Markets

The Federal Reserve, BOE, and BOJ bought government bonds in quantitative easing programs with the main goal of lowering long-term interest rates. The analysis in IMF (forthcoming) found that these policies were broadly effective in reducing interest rates in these markets. Forward guidance has also kept yields on government bonds low. The longer the guidance is in place, however, the more complacent markets may become about the implicit promise of intervention. So far, studies have suggested that the Federal Reserve's interventions have not impaired market functioning (Fleming and Mizrach, 2009; Engle and others, 2012). Market indicators appear to support this conclusion: overall, in the United Kingdom and the United States, the price impact of trade was relatively stable during periods of central bank asset purchases, and in Japan it appears to have fallen (Figure 3.4). With the possible exception of the first round of QE by the Federal Reserve, correlations between central bank purchases of government bonds and liquidity indicators such as price volatility, turnover, and the price impact of trade are generally small (Figure 3.5).

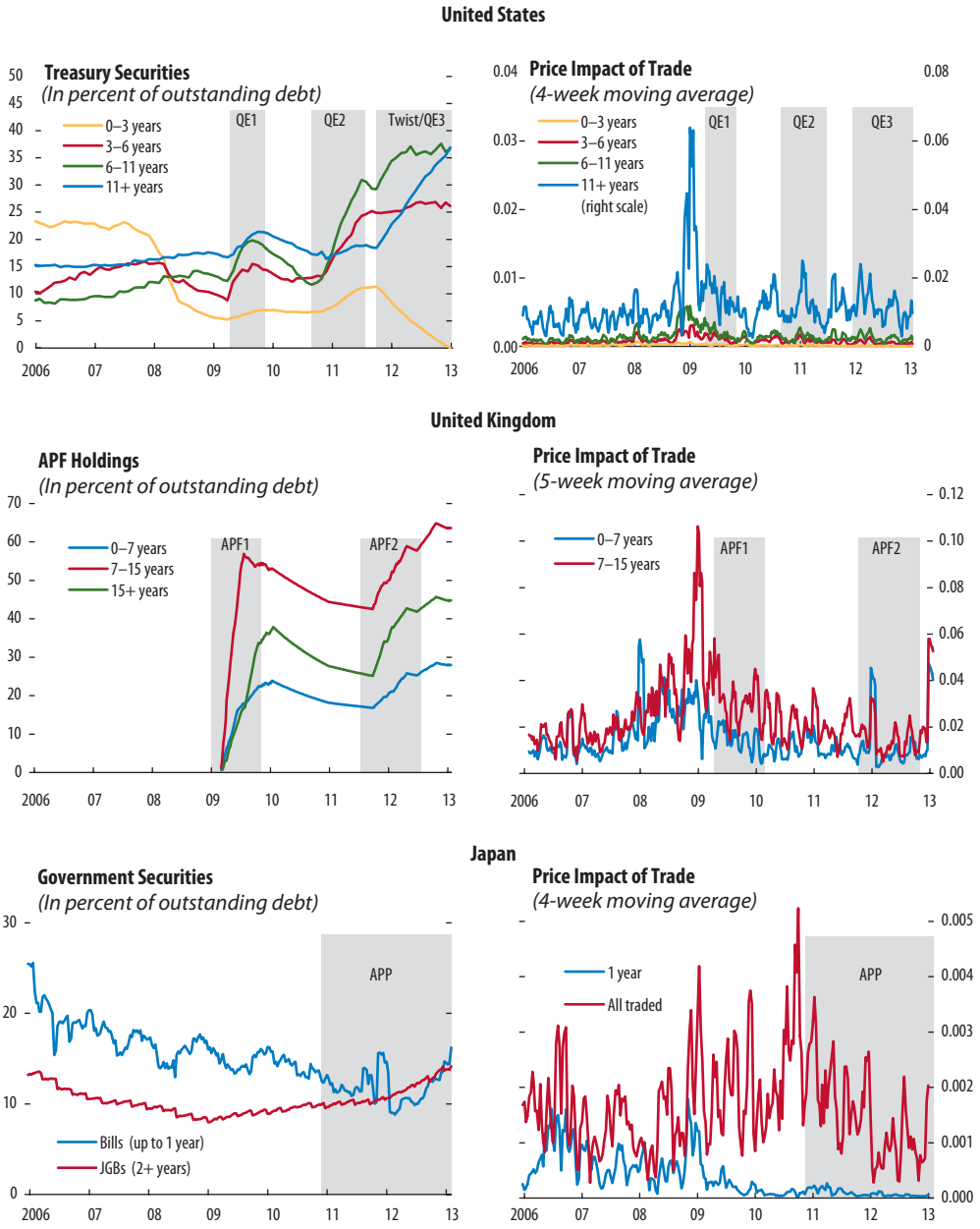
Through its Securities Market Programme (SMP), the ECB temporarily sought to support sovereign bond markets in periphery euro area countries that showed signs of dysfunction. The Outright Monetary Transactions program (OMT), announced in September 2012, also aims at supporting targeted sovereign bond markets by reducing risk premiums on these targeted securities.[8] Yields on periphery sovereign bonds have declined significantly since the announcement of the OMT, even though the program has not yet been activated.

The increasing share of government bonds held by central banks may present risks to financial stability.

[7]In the euro area, although the ECB holds only 5 percent of outstanding covered bonds, it also played a large role in the primary market, purchasing about 10 percent of covered bond issuance in 2009, 5.5 percent in 2010, and nearly 4 percent in 2012. Covered bonds are also increasingly issued and retained by banks for use as a high-quality collateral source for accessing ECB lending facilities.

[8]The ECB's indirect credit easing through three-year liquidity operations in late 2011 and early 2012 are also seen to have improved liquidity conditions in some euro area sovereign bond markets.

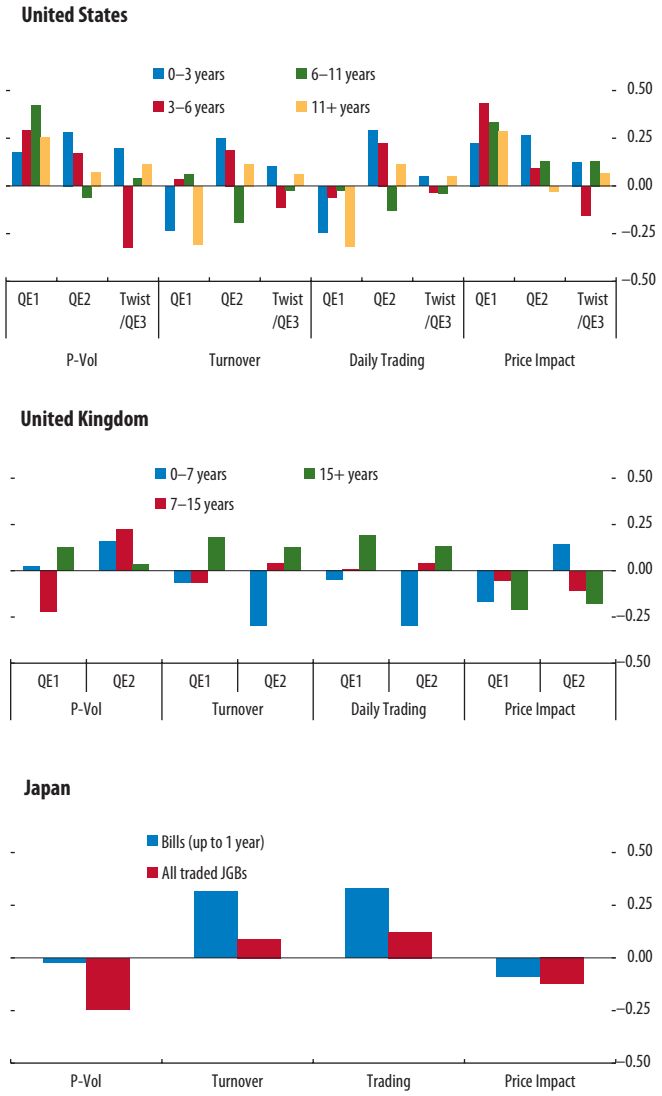
Figure 3.4. Central Bank Holdings of Domestic Government Securities and Market Liquidity, by Maturity



Sources: Bank of England; Bank of Japan; Bloomberg L.P.; Datastream; Federal Reserve Bank of New York; Japan, Ministry of Finance; Japan Securities Dealers Association (JSDA); JPMorgan Chase; U.K. Debt Management Office; U.S. Treasury; and IMF staff estimates.

Note: APF = Asset Purchase Facility (Bank of England); APP = Asset Purchase Program (Bank of Japan); JGBs = Japanese government bonds; QE = quantitative easing (Federal Reserve). Left panels are central banks' holdings of domestic government securities. QE1, March–October 2009; QE2, August 2010–June 2011; QE3, October 2011–present. APF1, March 2009–January 2010; APF2, October 2011–October 2012. APP, November 2010–present. Right panels show the price impact of trade, an indicator of market liquidity, defined as the weekly percentage price change (in absolute terms) divided by the weekly trading volume. Impact data are weekly for the United States and the United Kingdom, and at a 10-day frequency for Japan, interpolated from JSDA monthly data.

Figure 3.5. Correlations between Central Bank Holdings of Government Securities and Market Liquidity, by Maturity of Holdings



Sources: Bank of England; Bank of Japan; Bloomberg L.P.; Datastream; Federal Reserve Bank of New York; Japan, Ministry of Finance; Japan Securities Dealers Association (JSDA); JPMorgan Chase; U.K. Debt Management Office; U.S. Treasury; and IMF staff estimates.

Note: JGBs = Japanese government bonds; P-Vol = conditional bond return volatility (see discussion below); QE = quantitative easing. Figures show correlations between central bank holdings of government securities (as a percent of outstanding debt by maturity segment) and four indicators of liquidity in the government bond market during periods of active quantitative easing . P-Vol is estimated from daily data (log first differences), with an exponential Garch(1,1) process, allowing for asymmetric leverage effects. Trading is the average daily trading volume during a particular week. Turnover is weekly trading volume divided by the outstanding stock of debt (by segment). Price impact is the weekly percentage price change (in absolute terms) divided by the weekly trading volume. For Japan, turnover and trading data are interpolated from JSDA monthly volumes to tri-monthly periods.

The Federal Reserve and the BOJ now each hold some 10 percent of their respective governments' debt, the BOE holds 25 percent, and the ECB holds an estimated 5 percent to 6 percent of the outstanding sovereign debt of Italy and Spain. The shares of Federal Reserve and BOE holdings of longer-dated sovereign bonds are even higher at more than 30 percent. The central banks' large holdings could affect market expectations. Once economic conditions warrant the withdrawal of monetary stimulus, markets may anticipate that central banks will switch from buying government bonds to actively selling them, and political pressure may be exerted to move the monetary authorities in that direction. Such expectations could sharply drive up yields.[9] Therefore, it will be important that, well in advance of the need for tightening, central banks communicate the circumstances in which a tightening may occur and clarify that tightening need not imply outright selling of bonds from the central bank's balance sheet.[10] To the extent that large holdings of government bonds could result in large implicit or explicit losses for central banks (if the securities are marked to market or sold before maturity), it will be important to have arrangements in place that ensure adequate capital or indemnification for losses (Box 3.3).

Effects on Other Markets

Markets that are not directly targeted by MP-plus policies may nonetheless be affected. Credit easing, quantitative easing, and commitments to prolonged low policy interest rates may trigger flows into other mature asset markets (corporate bonds, equities, commodities, secondary currencies, and even housing). While encouraging a certain degree of risk taking is indeed the purpose of many MP-plus policies, they could unintentionally lead to pockets of excessive search for yield by investors and to exuberant price developments in certain markets, with the potential

[9]In 1994, the Federal Reserve caught market participants off guard by suddenly raising policy rates, causing turmoil in bond markets and especially in the agency MBS market, where investors insufficiently understood prepayment risks.

[10]The implications of government bond holdings on commercial banks' balance sheets are discussed in the final section of the chapter.

Box 3.3. Balance Sheet Risks of Unconventional Policy in Major Central Banks

Risks on balance sheets of central banks have increased since the start of the crisis, with potential negative consequences for their financial strength and independence.

Enhanced liquidity provision, relaxation of collateral rules, and sizable asset purchases have led to increases in the absolute size of central bank balance sheets, an increase in the duration and diversity of assets, and a decline in asset quality. These changes pose risks, including:

- Implicit or explicit valuation losses as a result of a rise in interest rates;
- Declines in operating income when central banks increase their holdings of long-dated securities with low coupon interest rates; and
- Possible impairment losses on assets with credit risk.

The extent to which the various central banks are exposed to these risks differs, depending on the scope and nature of their unconventional policies (which themselves may be influenced by a central bank's risk tolerance). The Federal Reserve, Bank of England (BOE), and Bank of Japan (BOJ) purchased large quantities of bonds to lower long-term yields and support economic activity, whereas the European Central Bank (ECB) mainly expanded the provision of liquidity to support bank funding (see Table 3.1).

- The Federal Reserve holds a large portfolio of Treasury securities and mortgage-backed securities (16 percent of GDP at end-2012), and it has extended the maturity of its holdings of Treasury securities considerably over time: its modified duration—a measure of interest rate sensitivity—increased from about 2¾ before the crisis to nearly 8 most recently. This means that a 1 percent increase in interest rates would reduce the portfolio's market value by 8 percent; and taking into account bond price convexity, the drop in market value would correspond to a capital loss of about 4 percent of the Federal Reserve's total assets.
- The BOJ and BOE are also subject to interest rate risk given their sizable government bond holdings (about 24 percent of GDP each at end-2012). A 1 percent increase in interest rates could result in a loss of about 1¾ percent of total assets for the BOJ and 6½ percent for the BOE.[1] For the BOJ, this figure could increase on further implementation of its Asset Purchase Program. In addition, the BOJ is also subject to market risk from its holdings of private assets.[2]
- The ECB increased its lending exposure to banks in euro area periphery countries from 20 percent of total refinancing operations in 2006 to about two-thirds in 2012, which raised its credit risk profile. These risks are mitigated to a considerable extent by collateral requirements. The ECB is also exposed, but to a lesser extent, to credit and interest rate risks arising from holdings of covered bonds and periphery sovereign bonds.

Central banks can mitigate these risks in various ways.

- Shorten asset duration so that seigniorage income matches central bank policy expense (for example, central banks could negotiate an asset swap with national treasuries to boost income).
- Increase the share of higher-yielding assets—this would most easily be accomplished by purchasing such assets during exit from MP-plus.
- Increase capital buffers to cover potential losses, through profit retention or capital injection. For example, even before most of its interventions, the ECB doubled its subscribed capital to €10.8 billion at end-2010. Similarly, in 2011, the BOJ retained profits in excess of legal requirements to build up capital reserves.
- Adjust haircut requirements to reflect changes in the quality of collateral.
- Secure a full indemnity from national treasuries for losses associated with MP-plus. For example, the BOE's Asset Purchase Facility is fully indemnified by its Treasury, and therefore the BOE does not face associated financial risks.

Note: Prepared by Kotaro Ishi, Raphael Lam, Kenneth Sullivan, and Nico Valckx.

[1]The BOE's exposures are kept off-balance-sheet in the BOE Asset Purchase Facility Fund.

[2]The BOJ's holdings of private sector securities are small and thus pose relatively limited balance sheet risk despite occasional unrealized losses. The BOJ does not face substantial credit risk on its lending facility, as it requires pooled collateral. The BOE's Funding for Lending Scheme also entails some credit risk, albeit only a limited amount given the small size of the program.

Box 3.3 *(continued)*

The extent to which these different measures can be used by central banks differs, depending on risk exposure and tolerance, institutional setup, and economic and financial circumstances.

In addition, the extent to which these holdings represent risks and are being recognized depends on accounting rules and how central banks intend to use the securities. If they intend to hold the securities to maturity, potential capital losses will not be realized if interest rates rise (although interest income would be below markets rates until maturity). The Federal Reserve, the ECB, and the BOJ value their holdings of securities at amortized costs, although in certain circumstances they are required to take on "impairments" if values drop substantially. In contrast, the BOE uses mark-to-market accounting for government bonds and other securities. The current ECB portfolios are held to maturity (and therefore not subject to marking to market) but a possible future Outright Monetary Transactions portfolio would be marked to market. However, in all cases, market participants will likely impute the values of central bank holdings of securities to evaluate their overall safety and soundness. It behooves central banks, therefore, to manage their risks in a transparent and consistent fashion.

Experience in some jurisdictions (mostly emerging market economies) has shown that central banks can execute their monetary policy functions while experiencing large losses (or even while having negative net worth), but such situations may nevertheless threaten their independence and credibility. Historical evidence shows that financially weak central banks are prone to government interference (Stella, 2008; and Stella and Lönnberg, 2008), thereby potentially undermining their policy performance. The extent to which independence is compromised by financial weakness would depend crucially on other safeguards for independence that are in place for a particular central bank.

for bubbles. Chapter 1 evaluates various potential transmission mechanisms. The sharp rise in investor demand for credit products, combined with constrained supply, is supporting a substantial decline in corporate borrowing costs. In turn, investors are accommodating higher corporate leverage and weaker underwriting standards to enhance yield. Some components of the credit market, such as loans with relaxed covenants, are experiencing more robust growth than in the last credit cycle (see Chapter 1).[11]

Although not analyzed here, the potential spillover effects of MP-plus to other economies are important. MP-plus could affect financial stability in liquidity-receiving economies via three main channels: excessive currency movements, domestic asset price bubbles, and sudden stops once the global liquidity is unwound. IMF (forthcoming) explores actual and potential spillover effects from MP-plus. Early MP-plus announcements, which strengthened market and financial stability in the advanced economies, buoyed asset prices globally and led to the appreciation of currencies of emerging market economies. These announcements mostly drew money back to the United States, while later announcements sent money to emerging markets, though with more muted effects on asset prices. More broadly, aggregate capital inflows to emerging market economies have mostly returned to their ample precrisis levels. Nevertheless, Chapter 1 finds that pockets of potential risk in some countries with more persistent capital inflows are raising the possibility of excesses in some important segments of emerging market economies. For example, a unique feature of the current cycle is that corporations in such economies have increased foreign-currency debt financing in place of local-currency equity. While these debt levels are not yet threatening, conditions are in place for a less favorable outcome if the trend continues.[12]

Effects of MP-Plus on Financial Institutions

To quantify the effects of MP-plus on the soundness of domestic financial institutions, the analysis here will

[11]These effects are covered in the September 2011 GFSR and in the forthcoming IMF paper. See also BIS (2012b).

[12]Spillovers are also discussed in the April 2010 GFSR, as well as in IMF (2012b) and BIS (2012a).

focus on banks. Healthy banks are critical to financial stability and to effective monetary policy transmission, as the recent financial crisis has shown. Risks in banks are also potentially heightened because leverage is part of their business model. MP-plus affects banks directly through various channels, including by providing liquidity, lowering bank funding costs (through low interest rates), and supporting asset prices (through central bank asset purchases).[13] MP-plus also has important indirect benefits for banks: by supporting economic activity, it increases the demand for loans and lowers credit risk in bank loan portfolios.

The effect of MP-plus on bank risk and its relationship to financial stability should be evaluated carefully. One of the macroeconomic goals of MP-plus is arguably to encourage banks to contribute to economic growth by clearing troubled assets from their balance sheets and making more loans to sound borrowers (a "risky" activity). Financial stability would be threatened only if risk taking by banks was excessive and worsened their financial health. To evaluate financial stability effects, it is therefore necessary to look beyond narrow measures of bank risk to broad measures that would indicate a weakening of bank soundness, such as the z-score and bank default risk.[14]

The analysis uses three complementary approaches to assess the effects of MP-plus on banks. The first is an event study, which is based on the idea that any effects of MP-plus policy initiatives on bank soundness (including bank default risk and performance) should immediately be reflected in changes in bank stock prices, since the stock price is a risk-adjusted discounted value of future bank income streams. Similarly, any effects of MP-plus on bank default risk should immediately be reflected in bank bond spreads. Relating a measure of MP-plus policy actions to these market indicators at the time of an MP-plus policy announcement can therefore offer some insight into market participants' current view of their impact.

The second approach furthers the understanding of the channels of impact on banks by using bank-level data. It relates indicators of monetary policy to measures of banks' financial health, including profitability, risk taking, and the status of balance sheet repair.

The third approach focuses on a possible rise in interest rate risk in banks—a potential consequence of the prolonged period of low interest rates. It examines two main channels through which banks are affected by increases in interest rates: net interest income and the value of fixed-rate securities (mainly government bonds).

Event Study

The event study analyzes the effect of MP-plus policy announcements on domestic bank stock prices and bank bond spreads. A complication is that announcements may be partly expected and priced into the markets before the actual announcement. Any measured effect on bank stock prices and bank bond spreads may therefore seem muted when compared with the announced measures. These prices would react only to new information, that is, the unexpected or surprise element of the announcement. Bernanke and Kuttner (2005) and Gürkaynak, Sack, and Swanson (2005) show that the surprise element of monetary policy announcements can be measured by changes in forward rates at the time of announcement.[15] These changes, representing the surprise element of the announced policies, could then be related to changes in bank stock prices and bank bond spreads to gauge their perceived impact on bank health.

The event study used here gives an indication of the *market perception* of the effects on banks' equity of the announced policies. Regressions of bank stock returns on the policy surprise measure—the change in interest rate futures—yield the following results (Table 3.2):

- Bank stock prices are not affected by a surprise easing of monetary policy in the United States; but in the United Kingdom, bank stocks fall 6.6 basis

[13]For a more thorough treatment of the various channels of transmission of MP-plus, see IMF (forthcoming).

[14]The z-score is a standard measure of bank soundness that is inversely related to a bank's probability of insolvency; see Laeven and Levine (2008) as well as the notes to Table 3.7 in Annex 3.2.

[15]The one-year-ahead futures rate is used to measure the monetary policy surprise (see notes to Table 3.2 for details) to capture both the contemporaneous part of monetary policy announcements (the target policy rate) and any expected near-term future developments (for example, forward guidance). With the short-term interest rate approaching zero in later years, the movements in the one-year-ahead futures rate may be limited and thus may affect the coefficients in the regressions for the MP-plus period. Partly for this reason, surprises are allowed to have differential effects between the conventional and MP-plus periods.

Table 3.2. Results from Event Study Regressions[1]

United States				
	Effect on Bank Stock Return MSCI Bank Stock Index (Daily returns, in percent)	Effect on Financial Sector Credit Risk Financial Sector Bond–Government Bond Spread[2] (Daily changes, in basis points)		
		1–3 year	3–5 year	5–7 year
Effect of a surprise monetary easing, per basis point	—	0.078***	0.087***	0.075**
Additional effect of MP-plus easing, per basis point	—	—	—	—
Constant	—	—	—	—
Change in constant, MP-plus events	—	—	—	—
Number of observations	103	103	103	103
R-squared	0.085	0.066	0.090	0.044
Euro Area				
	Effect on Bank Stock Return MSCI Bank Stock Index (Daily returns, in percent)	Effect on Financial Sector Credit Risk Financial Sector Bond–Government Bond Spread[2] (Daily changes, in basis points)		
		1–3 year	3–5 year	5–7 year
Effect of a surprise monetary easing, per basis point	–0.056**	0.126***	0.154***	0.130***
Additional effect of MP-plus easing, per basis point	–0.129**	0.156*	—	—
Constant	—	—	—	—
Change in constant, MP-plus events	—	—	—	—
Number of observations	156	156	156	156
R-squared	0.187	0.212	0.215	0.121
United Kingdom				
	Effect on Bank Stock Return FTSE All Share (Bank) Index (Daily returns, in percent)	Effect on Financial Sector Credit Risk Financial Sector Bond–Government Bond Spread[2] (Daily changes, in basis points)		
Effect of a surprise monetary easing, per basis point	–0.066***	0.071***		
Additional effect of MP-plus easing, per basis point	—	—		
Constant	—	—		
Change in constant, MP-plus events	—	—		
Number of observations	138	138		
R-squared	0.089	0.033		

Sources: Bank of America Merrill Lynch; Bloomberg L.P.; and IMF staff estimates.

Note: ***, ** and * indicate that estimated coefficients are significant at the 1 percent, 5 percent, and 10 percent level, respectively. — indicates that the coefficient was not significant at the 10 percent level; these coefficients are not reported in the table. The conventional policy period is from January 2000 through July 2007, and the MP-plus period is restricted to events after the Lehman Brothers collapse through October 2012. For the United States, the sample excludes September 12, 2001. A surprise monetary easing is measured by the change in the one-year-ahead three-month Eurodollar futures rate for the United States, the equivalent Euribor futures rate for the euro area, and the equivalent Sterling futures rate for the United Kingdom.

[1]For ease of interpretation, coefficients are reported so that a positive coefficient indicates a rise in returns or the bond spread as a result of monetary easing.

[2]All maturities are used for the United Kingdom because short-term spreads are not available. Adjusted for any options of corporate bonds, such as early retirement.

points per basis point of surprise monetary easing. These effects are the same for conventional easing and for MP-plus easing. In the euro area, bank stocks fall 5.6 basis points per basis point of surprise conventional easing and an *additional* 12.9 basis points per basis point of MP-plus easing.

- The markets see the risk of future bank default rising as a result of a surprise monetary easing, indicated by an increase in the spread between medium-term bank bonds and government bonds over various maturities. Each basis point of surprise easing increases these spreads by between 0.071 and 0.154 basis point, depending on the country and the specific maturity of the bonds. This effect is the same for conventional easing and for MP-plus in most cases, although there is weaker evidence of an additional rise in the spread of 0.156 basis point for a surprise 1 basis point MP-plus easing in the euro area.

In sum, the market perceives monetary easing in general as neutral or negative for bank health (as measured by bank stock prices), and considers it as increasing bank default risk in the medium term.

The perceptions for conventional easing are generally not different from those for MP-plus measures. This finding is surprising in that it runs counter to the financial stability objectives of policymakers. It may be an indication that even though policies have aimed at supporting the macroeconomy and fostering financial stability in the short term, they may nevertheless carry risks for bank soundness over the medium term. Moreover, if the market believes that central banks have superior information on economic conditions, a surprise easing may be seen as signaling that the central bank believes that conditions are worse than the market perceived, leading to a fall in bank stocks immediately after the announcement.[16]

Bank-Level Data Analysis

The second approach to investigating the effects of MP-plus on bank soundness is to use bank-level data to measure financial health. Whereas the event study looked at market perceptions of bank soundness and risk, this approach uses a panel regression methodology that directly relates indicators of monetary policy to various measures of bank soundness—bank profitability, risk taking, and efforts toward balance sheet repair. The required data are available for relatively few banks in the euro area, Japan, and the United Kingdom, making a conclusive analysis for them more difficult. The analysis therefore focuses on the United States. The monetary policies considered cover conventional as well as unconventional measures.[17]

The results from bank-level data analysis need to be interpreted with caution. The analysis uses the monetary policy variables as independent variables, assuming they "cause" the changes in the bank soundness indicators. However, the central bank actions since 2007 have been partly *in response to* problems in banks, so they may not be truly independent. The analysis made adjustments to work around this problem and to better capture the effects of MP-plus on bank soundness (see Annex 3.2). In addition, by using data only for the United States, the analysis covers the banks for which improvements in soundness have been most evident.

Another issue is that, besides the influence of monetary policy, bank balance sheets have been affected by fiscal, financial, and other factors over the period. The regressions therefore also include variables controlling for output growth, fiscal policies, and stress in the financial system (see Annex 3.2). Still, the analysis may not be able to fully capture the direct effects of MP-plus policies on banks if those policies manage to raise economic growth and thereby indirectly benefit the financial health and riskiness of banks.

The estimated effects of MP-plus on banks' income statements and balance sheets are mixed. The analysis calculates the effects of (1) monetary easing itself, (2) a sustained period of easing, and (3) an expansion of the central bank balance sheet (Table 3.3).[18] The analysis suggests that over the sample period, MP-plus has not appreciably affected the profitability of banks and may reduce some measures of risk in banks over the medium term; but it also suggests that MP-plus may be delaying balance sheet repair by banks, thereby potentially offsetting the risk reduction effects. Specifically:

- On risk taking, the analysis shows that MP-plus policies appear to be achieving their intended effects, with banks increasing their risky assets in response to the prolonged period of low interest rates (an indicator of MP-plus shown in the second group of rows in Table 3.3).[19] The low interest rates have also tended to decrease leverage (increase equity over total assets), but although it is statistically significant, the effect is so small as to be economically insignificant.

[16]In Japan (not included in our event study), the January 22, 2013, Joint Statement by the government and the BOJ has been associated with increases in bank stock prices. While these developments are too recent for a full analysis, the explanation for this opposite result may be that the announced policies have been seen as increasing the likelihood of ending deflation and improving economic prospects in general, benefiting banks and thereby buoying bank stocks.

[17]See Annex 3.2 for details on the estimation methodology and Table 3.7 for detailed results.

[18]The calculation of the effects reported in Table 3.3 uses the statistically significant estimated coefficients reported in Annex 3.2, Table 3.7.

[19]The first result is consistent with findings in previous empirical studies on the precrisis period, which showed a significant association between low interest rates and bank risk taking (De Nicolò and others, 2010; Altunbas, Gambacorta, and Marqués-Ibañez, 2010; and Dell'Ariccia, Laeven, and Suarez, 2013).

Table 3.3. Marginal Effect of MP-Plus on Banks

	Net Interest Margin (In percent of average earning assets)	Risk-Weighted Assets/Total Assets (In percent)	Capital Adequacy Ratio (Equity to Risk-Weighted Assets)[1] (In percent)	Z-score	Equity Ratio (Equity /Total Assets) (In percent)	Loan Loss Provisions/ Total Loans (In percent)
Sample mean	3.750	73.552	13.656	32.265	9.730	0.212
1. A 100-basis-point decrease in the Taylor gap						
Short-term effect (after a quarter)	–0.019	. . .	. . .	0.717	0.055	0.012
Effect after two years[2]	–0.070	. . .	. . .	3.510	0.250	0.035
Long-term effect[2]	–0.079	. . .	. . .	4.878	0.322	0.037
2. More quarters of very loose monetary policy[3]						
Short-term effect of one more quarter of very loose policy	. . .	0.880	–0.163	1.293	. . .	. . .
Effect of one more year	. . .	7.713	–1.432	11.165	. . .	. . .
3. An increase in central banks' assets by 1 percent of GDP						
Short-term effect (after a quarter)	–0.013	. . .	. . .	0.251	. . .	–0.023
Effect after two years[2]	–0.048	. . .	. . .	1.229	. . .	–0.067
Long-term effect[2]	–0.054	. . .	. . .	1.707	. . .	–0.070

Source: IMF staff estimates.

Note: The table reports the marginal effects of a change in each of the monetary policy variables on banks, assuming all other variables remain constant. The effects are computed from the coefficients on the monetary policy variables in Table 3.7 that are statistically significantly different from 0 at the 5 percent threshold.

[1]The capital adequacy ratio (CAR), defined here as equity over risk-weighted assets (RWA), was not considered as a dependent variable in the panel regressions. Yet translating the effects on RWA/total assets into effects on the CAR allows for a more intuitive interpretation of the results. The effect on the CAR is computed by assuming that only the composition of assets changes (change in RWA), not the total assets, nor the total equity. This assumption is implicit in the regression since we control for the equity ratio on the right-hand side. Capital adequacy ratio = equity/RWA = (equity/total assets)/(RWA/total assets). Then the percent change in CAR (ΔCAR/CAR) is approximately equal to the percent change in the equity ratio (assumed to be zero) minus the percent change in the RWA/total assets ratio. The reported short-term effect (ΔCAR) is computed as minus the marginal effect on RWA/total assets multiplied by the average CAR (13.656 percent), divided by the average RWA-to-total-assets ratio (73.552 percent).

[2]The effects after two years and the long-term effects are computed taking into account the fact that the dependent variables are highly persistent (see coefficients on the lagged dependent variables in Table 3.7). For example, while the immediate effect of a 100-basis-point decrease in the Taylor gap on the z-score is equal to 71.7 basis points, the effect after two years increases to 71.7*(1 – 0.853^8)/(1 – 0.853) = 351 basis points, and the long-term effect (over an infinite horizon) reaches 71.7/(1 – 0.853) = 487.8 basis points.

[3]By "very loose monetary policy," we mean a policy rate below the Taylor rate (i.e., a negative Taylor gap). The effect of one more year of very loose monetary policy is computed by compounding the effect of one additional quarter of negative Taylor gap and adding the compounded effects of additional quarters. For instance, the effect of one more year of very loose monetary policy on the z-score equals 1.293*[(1 – 0.853^4) + (1 – 0.853^3) + (1 – 0.853^2)]/(1 – 0.853) + 1.293 = 11.165.

- On profitability, low policy rates and the increase in central bank assets have had a negative effect on banks' net interest margin, but the effect is again so small as to be economically insignificant.[20] This effect is the result of two opposing effects: low rates reduce funding costs for banks; but over time, revenues from new loans and fixed income securities also decline, offsetting the decline in funding costs.
- The benign developments in bank profitability are confirmed by the effect of MP-plus on bank z-scores. The z-score is an indicator of soundness that combines a bank's profitability and capitalization, and it appears to have increased as a result of the prolonged period of low interest rates and the expansion of central bank balance sheets. Although these developments in profitability and capitalization show no immediate deterioration in bank soundness, these measures do not reflect all components of bank health.
- A measure of loan performance suggests that some aspects of MP-plus may be delaying balance sheet repair by banks. Increased central bank assets (an indicator of MP-plus shown in the third group of rows in Table 3.3) tend to reduce loan-loss provisions. This may point to the risk that the ample liquidity provided by central banks is giving banks an incentive to evergreen (roll over) nonperforming loans instead of recording losses in their profit and loss accounts. An alternative view is that with MP-plus supporting economic activity, these loans are more viable and hence need fewer provisions.[21] A delay in balance sheet repair could be one reason for the market expectations of an increase in bank default risk over time that was found in the event study.
- The analysis does not find evidence that MP-plus affects different kinds of banks differently. The effects of MP-plus do not appear to depend on bank asset size, or the ratio of equity to total assets, or whether they are global systemically important banks.[22]

[20]The sign of the effect is in line, however, with other evidence that has found a positive relationship between the level of interest rates and net interest margins, as discussed in the next section.

[21]While the analysis for the United States would support both explanations, previous studies have found evidence for delays in balance sheet repair in Japan starting in the 1990s (Peek and Rosengren, 2003; Caballero, Hoshi, and Kashyap, 2008).

Interest Rate Risk in Banks

Banks are affected by an increase in interest rates mainly through the interest rate spread between their lending and borrowing (the net interest margin) and through their holdings of securities and derivatives. Indirect effects on loan performance also play a role. These effects can work in opposite directions, and the net effect of an increase in interest rates can be positive or negative for banks, depending on the maturity structure of their balance sheets and other factors.

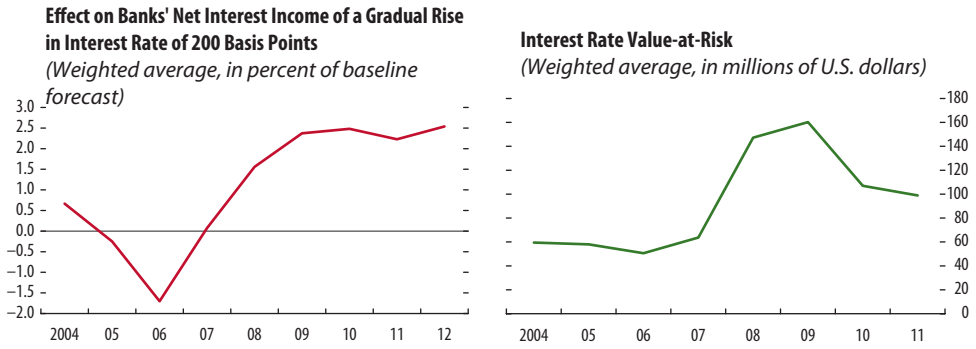
Estimates from a variety of sources suggest that—other things equal—an increase in interest rates would have a positive effect on the net interest income of banks. An analysis in BIS (2012a, Chapter 4) shows a positive relationship between the short-term interest rate and the net interest margin of banks in 14 major advanced economies. The slope of the yield curve also has a positive effect. Research by Federal Reserve economists comes to a similar conclusion for U.S. banks (English, Van den Heuvel, and Zakrajšek, 2012). U.S. banks themselves estimate that a rise in interest rates would increase their net interest income (Figure 3.6).

Interest rate increases can, however, also expose banks to losses since they reduce the market value of fixed-income assets (including government bonds), particularly if rates rise suddenly and unexpectedly. Such losses on government bonds are larger in a low-interest environment (see Table 1.4 in Chapter 1).[23] A hypothetical increase in interest rates from 2 percent to 4 percent would generate losses of 16 percent on the market value of a 10-year bond (Table 3.4). A Value-at-Risk analysis assesses banks' exposure to interest rate shocks on their trading portfolios. For U.S. banks, such an analysis shows a decline in

[22]In the regressions, interaction terms between these variables and the MP-plus variables were generally insignificant. The regression results including these interaction terms are not reported in Table 3.7.

[23]Bonds held in the "available for sale" category on a bank's balance sheet would suffer mark-to-market losses, but if they are in the "held to maturity" category, the losses would be unrealized and not recognized in the profit and loss statements. Market participants typically "see through" this accounting convention to estimate such losses.

Figure 3.6. Interest Rate Risk as Reported by U.S. Banks



Sources: Bloomberg L.P.; SNL Financial; and IMF staff estimates.

interest rate risk in their trading books, although that risk remains above its precrisis level (Figure 3.6).

Banks in Japan have a larger exposure to domestic sovereign debt than those in any other advanced economy (Figure 3.7; see also IMF (2012a) and the October 2012 GFSR). The BOJ (2012) notes that regional banks in Japan in particular are especially vulnerable to the risks of these large holdings: according to the BOJ, a 100-basis-point increase in interest rates across the yield curve would lead to mark-to-market losses of 20 percent of Tier 1 capital for regional banks and 10 percent for the major banks.

Holdings of sovereign debt by banks in Italy and Spain are also relatively high and have risen substantially since the beginning of the crisis. The Bank of Italy (2012) reports that a 200-basis-point increase in interest rates would cost Italian banks 7.7 percent of their capital through a combination of increases in net interest earnings and a fall in the value of their government bond holdings. Mitigating the risk of capital losses at Italian and Spanish banks is the fact that rates on their domestic sovereign bonds have been high recently because of elevated risk premiums on these bonds, and the premiums have recently been declining; a continued decline could offset to some extent the effects of a rise in policy interest rates.

Corporate bond holdings could also generate losses if interest rates rise, especially given the compressed yield spreads witnessed recently. However, bank holdings of corporate bonds are relatively low. In the fourth quarter of 2012, U.S. depository institutions held only 5.3 percent of their assets in corporate and foreign bonds (Board of Governors of the Federal Reserve System, 2013). Data from the ECB show that euro area banks hold 4.9 percent of assets in bonds issued by nonfinancial corporations and other nonbanks (excluding sovereign debt) and only 1 percent of total assets in bonds issued by nonfinancial corporations alone. Banks in the United Kingdom hold 4.1 percent and 0.3 percent, respectively, of their assets in securities associated with these same categories. Banks in Japan hold bonds in industrial corporations amounting to only 1.7 percent of assets. Given these small holdings, the associated interest rate risk is likely limited.

Effects of interest rate increases could also be felt indirectly through loan performance. Customers that have borrowed from banks at variable rates may find it more difficult to adjust: a sharp rise in interest rates could therefore raise nonperforming loan rates and the credit risk of banks. The extent

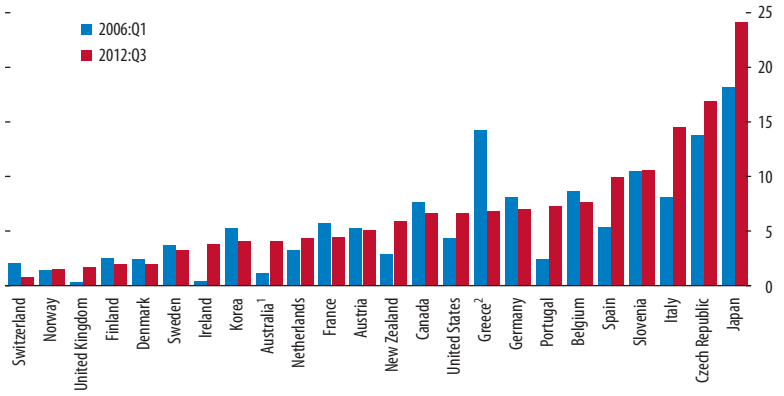
Table 3.4. Calculated Losses on a 10-Year Bond as a Result of a Rise in Interest Rates

	Coupon Yield on Bond		
	2 percent	4 percent	6 percent
Interest Rate Increases by	Final Bond Price		
1 percent	91	92	93
2 percent	84	85	87

Source: IMF staff estimates.

Note: Numerical example is based on a 10-year bond. Initial bond price is 100.

Figure 3.7. Bank Holdings of Government Debt in Selected Economies
(In percent of banking sector assets)



Sources: Central banks' and national regulators' websites; IMF, *International Financial Statistics* (IFS); and IMF staff estimates.

Note: Data on quarterly government debt holdings of domestic banks are taken from Arslanalp and Tsuda (2012). Government debt is defined as general government gross debt on a consolidated basis and includes securities other than shares, loans, and other short-term debt (not included elsewhere). Bank assets refer to IFS' other depository corporations.

[1]Australia data refer to 2012:Q2.

[2]The value of government debt holdings of Greek banks fell from 12.4 percent in 2011:Q4 to 8 percent in 2012:Q1, as a result of an official debt restructuring.

to which banks are affected by these losses also depends on the rationale that is moving the central bank to increase interest rates. For instance, if the cause is related to adverse supply shocks, the effect on banks may be larger than if it is related to an improving economic situation; banks and their borrowers would perform better in the latter case and thus be in a better position to absorb losses.[24]

The potential for capital losses on holdings of fixed-rate securities and loans in the short term can be significant, even though the net effect of interest rate increases would be positive for banks over the medium term. The positive effect of higher net interest income accumulates over time, offsetting the more immediate capital losses incurred predominately by banks with significant trading operations.[25]

Also, the positive effect on the net interest margin is important, since interest makes up well over half of bank income (some 80 percent in the United States and about two-thirds in the euro area, for example). Indeed, English, Van den Heuvel, and Zakrajšek (2012) report that interest rate changes affect bank profitability mainly through the effect on net interest income. This is in line with the finding summarized in Figure 3.6 that U.S. banks have decreased their interest rate risk since the peak of the crisis.

Conclusions and Policy Implications

MP-plus has involved the unprecedented intervention of major central banks in various asset markets, including sovereign and corporate bond markets, markets for asset-backed securities, and—indirectly—money and interbank markets. Banks have been affected by the prolonged period of very low nominal and real interest rates, by central bank asset purchases (through liquidity and price effects), and by direct liquidity support.

[24]The effect of MP-plus on inflation is discussed in Chapter 3 of the April 2013 *World Economic Outlook*.

[25]Recent stress tests performed by the Federal Reserve on participating bank holding companies (BHCs) in compliance with the Dodd-Frank Act showed that trading and counterparty credit losses of the 6 BHCs with significant trading activities amounted to $97 billion, 21 percent of total losses of all 18 BHCs and 27 percent of the total losses of the 6. The severely adverse scenario comprised adverse changes to several factors and included an increase in the 10-year Treasury yield of 100 basis points. These factors were imposed over the course of nine quarters. See Table 4 in "Dodd-Frank Act Stress Test 2013" (Federal Reserve Board, 2013) for more details.

The analysis finds little evidence that MP-plus has given rise to a serious immediate degradation of financial stability (Table 3.5). Overall, the effects of MP-plus are associated with improved bank soundness in the short term, a result in line with the financial stability objectives of policymakers. In addition, in some markets where central banks play a large role (including in interbank markets and in some sovereign bond markets in the euro area), MP-plus has been carried out in response to dysfunction; in those cases, central bank actions can be seen as preventing a worsening of market functioning.

Over the medium term, however, MP-plus may be generating risks that have not yet become evident in banks. Forward-looking indicators may be showing that the market is alert to these risks, with MP-plus (and conventional monetary easing) hurting bank stocks in some countries and increasing market perceptions of bank default risk. The main risks associated with MP-plus over the medium term are that:

- *Balance sheet repair in banks may be delayed.* There is some evidence that unconventional central bank measures may be supporting a delay in balance sheet cleanup in some banks, with MP-plus having a negative effect on loan provisioning. The current environment may also be encouraging banks to evergreen loans rather than recognize them as nonperforming, as noted in Bank of England (2012), with banks providing borrowers with flexibility to meet their obligations during periods of stress until economic conditions improve. But it is difficult to identify weak but ultimately viable borrowers, and such evergreening may be keeping nonviable firms alive; their demise when rates rise could affect the quality of the loan portfolio over the medium term. Indeed, the Bank of England (2012) suspects that loan forbearance partly explains the recent low corporate insolvency rate in the United Kingdom.
- *An eventual rise in interest rates may hurt some banks.* Banks in several countries are holding large amounts of government bonds. A rise in interest rates upon exit from MP-plus could lead to actual losses on banks' bond holdings held in the available-for-sale category.
- *Exit from markets where central banks still hold substantial amounts of securities may be challenging.* Central banks are holding large amounts of certain assets, particularly government bonds and securities linked to real estate. Expectations of central bank sales of these large holdings could lead to market disruptions, especially if the desired policy stance shifts quickly. The rapid repricing of bonds can result in losses for bond holders (both banks and central banks). These challenges highlight the importance of a well-planned and clearly articulated communications strategy for central bank exit from such markets.
- *The volume and efficiency of interbank lending may adjust to new, lower levels based partly on a reevaluation of counterparty risks.* With many banks now relying to a significant extent on central bank liquidity and banks withdrawing resources and skills from interbank lending activities, it may be difficult to restart these markets.

As the recovery proceeds and banking system risks begin to rise, MP-plus measures should be accompanied by micro- and macroprudential policies where needed, supported by robust data provision by financial institutions and vigorous risk-based supervision.[26] These risks are slow moving and may be masked by the near-term benefits of crisis-related measures, making it crucial that they be addressed promptly with prudential measures. The precrisis period has shown that corrective policies implemented after the risks reveal themselves may be too late to contain financial stability challenges.

Policies should be implemented in a measured manner, focused on areas showing rising vulnerabilities. Therefore, authorities should assess where pockets of vulnerabilities exist and quantify their systemic importance. For this, more robust data encompassing a larger share of the financial system are key. For example, more comprehensive bank-level data would allow the above assessment of the impact of various MP-plus measures to be replicated for countries besides the United States. These analyses should help identify which prudential measures are most suitable to deal with those risks. To the extent that risks are identified in specific financial institutions, these measures would have a microprudential focus. If the risks are affecting the financial system more broadly (systemic risks), the measures would

[26]For essential elements of good supervision, see IMF (2010b).

Table 3.5. Risks from MP-Plus and Mitigating Policies

Type of MP-Plus Policy	Associated Potential Risk	Risk Assessment	Evidence	Mitigating Policies
Prolonged periods of low interest rates	Pressure on the profitability and solvency of financial institutions	Low	Bank profitability currently not affected, but could decline over time	Robust capital requirements
	Excessive risk taking ("search for yield")	Low	May be indicated by medium-term increase in bank default risk	Vigilant risk-based supervision, robust capital requirements
	Evergreening, delay in balance sheet repair	Medium	May be indicated by decline in loan-loss provisions and increase in medium-term bank default risk	Vigorous pursuit of balance sheet repair
Quantitative easing	Dependence on central bank financing	Medium	Central bank liquidity is lowering spreads in interbank market in Japan and euro area	Improved liquidity risk management in banks, implementation of liquidity requirements, design of systemic liquidity risk mitigants
Indirect credit easing	Dependence on public sector financing	Medium	Central bank liquidity is lowering spreads in interbank market in Japan and euro area	Improved liquidity risk management in banks, implementation of liquidity requirements, design of systemic liquidity risk mitigants
	Distortion of allocation of credit, possibly weakening underwriting standards	Low	May be indicated by medium-term increase in bank default risk	Vigilant risk-based supervision, dynamic forward-looking provisioning, robust capital requirements
	Delay in balance sheet repair	Medium	May be indicated by medium-term increase in bank default risk	Vigorous pursuit of balance sheet repair
	Reinforcement of bank–sovereign links	Medium	Banks in some euro area countries have invested a larger share of assets in government bonds	Vigorous pursuit of balance sheet repair, robust capital requirements
Direct credit easing	Distortion in prices and market functioning	Low	Little evidence that central bank intervention has distorted prices or market functioning	Address associated market risks in banks

Source: IMF staff.

come from the macroprudential toolkit.[27] The appropriate measures should then be implemented in a measured manner that accounts for the importance of these risks and their likely evolution over time. Additionally, policymakers should be cognizant of the challenges of combining macroprudential and monetary policies, which have been explored in IMF (2013).

The following tools and policies can be useful in mitigating specific risks:

- *Well-designed dynamic and forward-looking provisioning,* supported by strong credit risk analysis and robust bank capitalization, should be employed to offset a rise in credit risk for banks resulting from delays in balance sheet repair (including evergreening).
- *Balance sheet repair and bank restructuring* should be vigorously pursued by supervisors (including through asset quality reviews), and low interest rates should not be allowed to cause delays. It is crucial that banks be able to function effectively again under more normal, postcrisis conditions. Future exit from MP-plus will involve interest rate increases that might challenge the soundness of banks with unviable loans or large quantities of assets that have been supported by central bank interventions in their markets. The completion of balance sheet repair in banks is a clear prerequisite for avoiding conflicts between monetary policy objectives and financial stability objectives upon exit from MP-plus.
- *Countercyclical bank capital rules* should be used to address market risks (including from potential asset price declines in markets targeted by MP-plus) and potential declines in bank profitability. Market risks would also be mitigated if the process of central bank exit is accompanied by strong public communications: explanations of the circumstances under which a tightening may occur and clarification that policy tightening need not imply sales of bonds by central banks.
- *Robust and forward-looking liquidity requirements* (such as the new liquidity coverage ratio under Basel III) that take into account systemic effects can address banks' funding challenges (including those posed by central bank exit from interbank intermediation). Risks of investor runs against MMMFs, exacerbated by low interest rates, should also be addressed, preferably through a move to variable net asset values, or—if stable net asset values are maintained—through more bank-like prudential regulation for these funds.

One reason for the failure of current bank portfolio measures to register these risks is that they may be shifting to the nonbank financial sector. Authorities should be alert to the possibility that risks may be shifting to other parts of the financial system not examined here, such as shadow banks, pension funds, and insurance companies (see Chapter 1). To avoid further encouragement of those shifts, more vigilant supervision of banks should be accompanied by enhanced supervision of other financial institutions. Although data collection is improving, a formal examination of leveraged nonbank financial institutions is still hindered by incomplete data, and market intelligence and other qualitative tools should be used to observe buildups of vulnerabilities outside the regulated sectors.

Even if the sales of central bank holdings are, as they should be, consistent with the desired stance of monetary policy, sensitive to market functioning, and well communicated, they could be complicated by shifts in market sentiment. Market interest rates may not respond symmetrically when the central bank switches to being a seller, particularly if the central bank underestimates the ability of markets to absorb the increased supply. A change in the risk sentiment of private bond investors may raise interest rates more quickly than they declined and, in extreme cases, could lead to market disruption. Central banks may be forced to retain a larger stock of government bonds on their balance sheets to prevent the yield curve from steepening too rapidly. A scenario of rapid interest rate increases could also expose central banks to realized losses on securities that they decide to sell. If central banks are to retain flexibility in setting future monetary policy objectives, it may be useful for them to recognize and address the risk of potential losses now, partly by ensuring that they have an appropriate loss-absorbing capacity.

In sum, implementing micro- and macroprudential policies that address potential adverse side

[27]For an overview of macroprudential policy tools, see Lim and others (2011).

effects on financial stability over the medium term would allow greater leeway for MP-plus policies to focus on macroeconomic goals. MP-plus appears to have contributed to financial stability, as intended, but risks associated with it will likely strengthen the longer it is maintained. Moreover, risks may be shifting to other parts of the financial system not examined here, such as pension funds and insurance companies. Chapter 1 examines how the solvency of such institutions is increasingly strained by a long period of low returns on assets and how the strain may be encouraging the observed rise in allocations to riskier asset classes such as alternative investments. Where appropriate, micro- and macroprudential policies for banks and other financial institutions, as well as careful planning of the exit from MP-plus, can be used to mitigate future conflicts between macroeconomic and financial stability objectives. As the experience with macroprudential policy tools is relatively limited, however, authorities should vigilantly monitor their effectiveness and stand ready to adjust the macroeconomic policy mix. Therefore, MP-plus should also continue, as it has, to keep financial stability goals in mind.

Annex 3.1. Key MP-Plus Announcements since 2007, by Central Bank

U.S. Federal Reserve

Date	Event	Characteristics	Assets/Maturity/Amount	Announcement	Type of MP-Plus
11/25/2008	Official	Start of program	GSE direct obligations: $100 billion MBS: $500 billion	The Federal Reserve will purchase up to $100 billion in agency debt and up to $500 billion in MBS. The Federal Reserve announces the creation of the Term Asset-Backed Securities Loan Facility (TALF).	DCE
12/1/2008	Speech	Expressed intention		Chairman Bernanke states that the Federal Reserve "could purchase longer-term Treasury or agency securities … in substantial quantities."	QE
12/16/2008	FOMC	Policy rate cut Forward guidance		The Federal Open Market Committee (FOMC) established the target range of the policy rate between 0 percent and 0.25 percent. The FOMC "anticipates … exceptionally low levels of the federal funds rate for some time." It also "stands ready to expand its purchases of agency debt and mortgage-backed securities … is also evaluating the potential benefits of purchasing longer-term Treasury securities."	Low i
1/28/2009	FOMC	Expressed intention		The FOMC "is prepared to purchase longer-term Treasury securities."	QE
3/18/2009	FOMC	Forward guidance Program expansion	MBS: $750 billion Agency debt: $100 billion Treasuries: $300 billion	The FOMC "anticipates … exceptionally low levels of the federal funds rate for an extended period." It will also purchase MBS, agency debt, and longer-term Treasury securities over the next six months.	DCE QE Low i
8/12/2009	FOMC	Program contraction	Treasuries	The FOMC "decided to gradually slow the pace" of Treasury purchases and removed "up to" language with reference to Treasury purchases limit.	QE
9/23/2009	FOMC	Program contraction	MBS	The FOMC "decided to gradually slow the pace" of MBS purchases and removed "up to" language with reference to agency MBS purchases limit.	DCE
11/4/2009	FOMC	Program contraction	Agency debt: $175 billion	The FOMC "will purchase … about $175 billion of agency debt" and removed "up to" language with reference to agency debt limit.	DCE
3/16/2010	FOMC	Keep policy		The FOMC decided to keep the policy stance against some dissent: "Voting against the policy action was Thomas M. Hoenig, who believed that continuing to express the expectation of exceptionally low levels of the federal funds rate for an extended period was no longer warranted because it could lead to the buildup of financial imbalances and increase risks to longer-run macroeconomic and financial stability."	General MP-plus
8/10/2010	FOMC	Expressed intention	Longer-term Treasuries	The Federal Reserve will reinvest "principal payments from agency debt and agency mortgage-backed securities in longer-term Treasury securities."	QE
8/27/2010	Speech	Expressed intention	Longer-term Treasuries	Chairman Bernanke announced that "additional purchases of longer term securities … would be effective in further easing financial conditions."	QE
9/21/2010	FOMC	Expressed intention		The FOMC "is prepared to provide additional accommodation if needed."	General MP-plus

11/3/2010	FOMC	Program expansion	Treasuries: $600 billion	The FOMC "intends to purchase a further $600 billion of longer-term Treasury securities by the end of the second quarter of 2011, a pace of about $75 billion per month."	QE
8/9/2011	FOMC	Forward guidance		This is the first time that the FOMC states explicitly the duration of the low rate policy: "The Committee currently anticipates that economic conditions—including low rates of resource utilization and a subdued outlook for inflation over the medium term—are likely to warrant exceptionally low levels for the federal funds rate at least through mid-2013."	Low i
9/21/2011	FOMC	Start of program	Buy longer-term Treasuries: $400 billion Sell short-term Treasuries: $400 billion	The FOMC "intends to purchase, by the end of June 2012, $400 billion of Treasury securities with remaining maturities of 6 years to 30 years and to sell an equal amount of Treasury securities with remaining maturities of 3 years or less."	QE
12/13/2011	FOMC	Keep policy		The FOMC decided to keep the policy stance against some dissent (Evans did not vote).	General MP-plus
1/25/2012	FOMC	Forward guidance		The FOMC states that the federal funds rate is likely to remain exceptionally low through late 2014.	Low i
6/20/2012	FOMC	Continue program		The FOMC "decided to continue throughout the end of the year its program to extend the average maturity of its holdings of securities."	QE
8/31/2012	Speech	Expressed intention		Jackson Hole Speech: "The Federal Reserve will provide additional policy accommodation as needed to promote a stronger economic recovery and sustained improvement in labor market conditions in a context of price stability."	General MP-plus
9/13/2012	Official Forward guidance	Start of program	MBS: $40 billion per month	The FOMC will purchase $40 billion MBS a month—open-ended. The Federal Reserve will also continue to maintain extremely low interest rates until at least mid-2015.	DCE Low i
12/12/2012	FOMC	Change forward guidance	Linked to economic indicators	The exceptionally low range for the federal funds rate will be appropriate at least as long as the unemployment rate remains above 6½ percent, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committee's 2 percent longer-term goal, and longer-term inflation expectations continue to be well anchored.	Low i

European Central Bank

Date	Asset/Maturity/Amount	Announcement	Type of MP-Plus[1]
8/9/2007	Fine-tuning liquidity operations	The 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.	ICE
8/22/2007	Three-month €40 billion longer-term refinancing operation (LTRO)	The ECB announces supplementary liquidity-providing LTRO.	ICE
3/28/2008		The ECB introduces six-month LTROs and supplementary three-month LTROs.	ICE

(continued)

Annex 3.1. Key MP-Plus Announcements since 2007, by Central Bank *(continued)*

European Central Bank

Date	Assets/Maturity/Amount	Announcement	Type of MP-Plus
10/8/2008	Fixed-Rate Full Allotment (FRFA) introduced	The ECB decides to carry out weekly refinancing operations with a fixed-rate tender procedure with full allotment (FRFA).	ICE
5/7/2009	One-year LTRO	Press conference announces three one-year FRFA liquidity-providing operations (in June, September, and December 2009).	ICE
5/7/2009	Covered bonds subject to collateral rules	Covered Bond Purchase Programme (CBPP) announced for €60 billion, one-year program (details followed in June 2009, launched July 6, 2009).	CE
12/3/2009	Indexation of one-year LTRO	Start of phasing out of exceptional liquidity policy: one-year LTRO at full allotment, but rate indexed over life of LTRO.	
3/4/2010	Indexation of six-month LTRO, variable three-month LTRO	Further phasing out of liquidity measures: three-month LTRO at variable rate and six-month LTRO at indexed rate.	
5/9/2010	Sovereign bonds	Securities Market Programme (SMP) launched to ensure depth and liquidity in dysfunctional market segments (government bonds).	CE
7/28/2010	Effective January 1, 2011	Collateral rules tightened (revised haircuts, asset category rankings).	
3/3/2011		The ECB continues Main Refinancing Operations (MROs) as FRFA for as long as necessary.	ICE
8/7/2011	Italian/Spanish sovereign bonds	SMP relaunched for Italy and Spain, acknowledging progress made by these countries on fiscal reform, but conditional on continued reforms.	CE
10/6/2011	Covered bonds subject to collateral rules, 10.5-year maximum maturity	CBPP2 announced for €40 billion, one-year program (November 2011–October 2012; detailed on November 3, 2011).	CE
12/8/2011	Three-year LTRO, December 20, 2011, and February 28, 2012	The ECB announced two three-year LTROs, reduced the reserve ratio from 2 percent to 1 percent, and expanded collateral availability, at the discretion of national central banks (NCBs).	ICE
2/9/2012	Specific national eligibility criteria and risk control measures apply	The ECB approves eligibility criteria for additional credit claims from seven NCBs.	ICE
8/2/2012	Maturity between one and three years. Bonds of EFSF/ESM program countries.	The ECB will start "outright transactions in secondary sovereign bond markets aimed at safeguarding an appropriate monetary policy transmission and the singleness of the monetary policy."	CE
9/6/2012	No ex ante size limits	Technical features of Outright Monetary Transactions (OMT) released, including strict and effective conditionality.	CE
9/6/2012	Ease collateral rules	Suspension of minimum ratings for OMT countries. Accept debt instruments in Japanese, U.K., and U.S. currency issued/held in the euro area.	ICE/CE

Bank of Japan

Date	Characteristics	Assets/Amounts	Announcement	Type of MP-Plus
12/1/2009	Start of program		Introduction of the fixed-rate funds-supplying operation against pooled collateral.	ICE
5/21/2010	Start of program		Introduction of the fund-provisioning measure to support strengthening the foundations for economic growth.	ICE
10/5/2010	Forward guidance		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."	Low i
10/28/2010	Start of program		Establishment of the Asset Purchase Program.	QE DCE

3/14/2011	Increase	Japanese government bonds (JGBs): 0.5 trillion yen Treasury bills: 1.0 trillion yen Commercial paper (CP): 1.5 trillion yen Corporate bonds: 1.5 trillion yen Exchange-traded funds (ETFs): 0.45 trillion yen Real estate investment trusts (J-REITs): 0.05 trillion yen	Increase in the size of the Asset Purchase Program, mainly risk assets.	QE DCE
8/4/2011	Increase	JGBs: 2 trillion yen Treasury bills: 1.5 trillion yen CP: 0.1 trillion yen Corporate bonds: about 0.9 trillion yen ETFs: about 0.5 trillion yen Fixed-rate funds-supplying operation against pooled collateral: 5 trillion yen J-REITs: about 0.01 trillion yen	Increase in the size of the Asset Purchase Program.	QE DCE
10/27/2011	Increase	JGBs: 5 trillion yen	Increase in the size of the Asset Purchase Program.	QE
2/14/2012	Increase	JGBs: 10 trillion yen	The Bank further "enhances monetary easing" and increases the size of the Asset Purchase Program.	QE
4/27/2012	Increase	JGBs: 10 trillion yen Fixed-rate funds-supplying operation against pooled collateral: reduction of 5 trillion yen	Increase in the size of the Asset Purchase Program and decrease of 5 trillion yen in the Bank's fixed-rate funds-supplying operation against pooled collateral with a six-month term.	QE
7/12/2012	No net increase	Treasury bills: 5 trillion yen Fixed-rate funds-supplying operation against pooled collateral: reduction of 5 trillion yen	The Bank "decided to adopt the following measures with the view to proceeding with the aforementioned monetary easing in a continuous manner by steadily increasing the amount outstanding of the Asset Purchase Program."	QE
9/19/2012	Increase	JGBs: about 5 trillion yen Treasury bills: about 5 trillion yen	Increase of 10 trillion yen in the size of the Asset Purchase Program.	QE
10/30/2012	Start of program		Introduction of fund-provisioning measure to stimulate bank lending.	ICE
10/30/2012	Increase	JGBs: about 5 trillion yen Treasury bills: about 5 trillion yen CP: about 0.1 trillion yen Corporate bonds: about 0.3 trillion yen ETFs: about 0.5 trillion yen J-REITs: about 0.01 trillion yen	Increase of 11 trillion yen in the size of the Asset Purchase Program.	QE DCE
12/20/2012	Increase	JGBs: about 5 trillion yen Treasury bills: about 5 trillion yen	Increase of 10 trillion yen in the size of the Asset Purchase Program.	QE
1/22/2013	Increase	JGBs: about 2 trillion yen per month Treasury bills: about 10 trillion yen per month	Introduced the "price stability target" and will introduce the "open-ended asset purchasing method" under the Asset Purchase Program (from 2014).	QE

(continued)

Annex 3.1. Key MP-Plus Announcements since 2007, by Central Bank *(continued)*

Bank of England

Date	Event	Characteristics	Assets/Maturity/Amount	Announcement	Type of MP-Plus
1/19/2009		Expressed intention		The chancellor of the Exchequer announces that the Bank will set up an asset purchase program.	General MP-plus
1/29/2009		Program established		Asset Purchase Facility established.	General MP-plus
2/11/2009	Report	Strong indication		Inflation Report and associated press conference give strong indication that QE is likely.	QE
3/5/2009	MPC	Start of program	Gilts: £75 billion; 5–25 years	The Monetary Policy Committee (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 5 and 25 years.	QE
5/7/2009	MPC	Program expansion	Gilts: £50 billion	The MPC announces that the amount of QE asset purchases will be extended by a further £50 billion to £125 billion.	QE
8/6/2009	MPC	Program expansion	Gilts: £50 billion; three or more years	The MPC announces that QE asset purchases will be extended to £175 billion, and the buying range will be extended to gilts with a residual maturity greater than three years.	QE
11/5/2009	MPC	Program expansion	Gilts: £25 billion	The MPC announces that QE asset purchases will be extended to £200 billion.	QE
2/4/2010	MPC			The MPC announces that QE will be maintained at £200 billion.	QE
10/6/2011	MPC	Program expansion	Gilts: £75 billion	An increase of £75 billion in size of asset purchases.	QE
2/9/2012	MPC	Program expansion	Gilts: £50 billion	An increase of £50 billion in size of asset purchases.	QE
7/5/2012	MPC	Program expansion	Gilts: £50 billion	An increase of £50 billion in size of asset purchases.	QE
7/12/2012	News release	Announcement of program		Funding for Lending Scheme (FLS) is announced, which is designed to boost lending to the real economy.	ICE

Sources: Respective central banks; news reports; and IMF staff estimates.

Note: EFSF = European Financial Stability Mechanism; ESM = European Stability Mechanism; GSE = government-sponsored enterprise; MBS = mortgage-backed securities. Definition of type of MP-plus: CE = credit easing; DCE = direct credit easing; Low i = a prolonged period of low interest rates; ICE = indirect credit easing; QE = quantitative easing.

[1]Entities in this column conform to the classification in this chapter although the ECB's objective for these measures was primarily to support the transmission of monetary policy.

Annex 3.2. Estimation Method and Results for the Panel Regressions

Bank-level panel regressions were used to investigate the channels through which MP-plus policies can affect banks. Three channels were considered: bank profitability, risk taking by banks, and efforts toward balance sheet repair.

Bank profitability is measured by the net interest margin, defined as net interest income (on a fully taxable-equivalent basis if available) as a percent of average earning assets. Risk taking is proxied by three variables: (1) the ratio of risk-weighted assets to total assets, in which risk-weighted assets are a weighted sum of a bank's assets with weights determined by the riskiness of each asset according to banking regulations and the bank's internal models; (2) the z-score, defined as the ratio of the return on assets plus the ratio of equity over total assets, divided by the standard deviation of asset returns over 12 quarters (the z-score is inversely related to a bank's probability of insolvency, and thus a higher z-score is interpreted as lower bank risk); and (3) the equity ratio, defined as the ratio of equity to total assets. Efforts toward balance sheet repair are proxied by the ratio of the provisions for possible losses on loans and leases (excluding provisions for possible losses on real estate owned) to total (gross) loans.

The stance of monetary policy is captured by the difference between the policy rate and the rate given by a standard Taylor (1993) rule (the "Taylor gap"). For robustness, an average of four estimates of the Taylor rate was used (see Table 3.6 and Figure 3.8). When the Taylor gap indicates that the interest rate should be below zero, the central bank may choose to employ unconventional measures (such as QE). In the regressions, such measures are summarized by the change in the ratio of central bank assets to GDP. In addition, the regressions include a measure of the length of time during which the policy rate stayed below the Taylor rule rate over the previous five years to represent prolonged periods of exceptionally low interest rates (in itself an unconventional measure).

To deal with possible endogeneity issues, several adjustments were used. First, by using a one-period lag of most explanatory variables, the analysis reduces the extent to which the results measure a response of the central bank to problems in banks. Also, the regressions were estimated using the Arellano-Bover/Blundell-Bond system generalized method of moments estimator (Arellano and Bover, 1995; and Blundell and Bond, 1998) to further alleviate endogeneity issues. The number of lags used (and hence the number of instruments) varies according to the dependent variable and the sample size. Finally, by including time dummies, the analysis takes into account some of the direct effects of the crisis on bank soundness. Another potential issue is that bank risk characteristics and central bank balance sheets (one of our measures of MP-plus) tend to have little variability during normal times, giving the regression less power to find a statistical relationship between the variables. However, the movements in these variables during the crisis have been more pronounced and hence likely provide some statistical power to measure the effects.

The dataset consists of quarterly balance sheet data for listed U.S. commercial banks from the SNL Financial database and U.S. macroeconomic data over the period 2007:Q3–2012:Q3. The full sample includes data for 614 banks. Because all variables

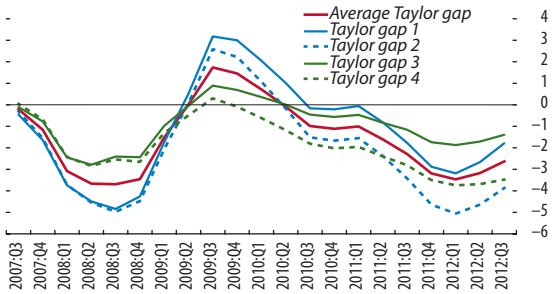
Table 3.6. Specification of Taylor Rule

	Long-Run Real Interest Rate	Inflation Objective	Weight on Inflation Deviation	Inflation Deviation	Weight on Output Gap	Output Gap
1	Growth rate of potential output	2 percent	1.5	Current inflation – 2 percent	0.5	WEO estimate
2	Growth of H-P trend of real GDP	2 percent	1.5	Current inflation – 2 percent	0.5	Deviations from H-P trend
3	Growth rate of potential output	2 percent	0.5	Current inflation – 2 percent	0.5	WEO estimate
4	Growth of H-P trend of real GDP	2 percent	0.5	Current inflation – 2 percent	0.5	Deviations from H-P trend

Source: IMF staff estimates.

Note: H-P trend = Hodrick-Prescott filter trend; WEO = World Economic Outlook database. The table indicates the four versions of the Taylor rule equation that were used in the panel regressions. The general specification is the following: Taylor rule = Long-Run Real Interest Rate + Inflation Objective + Weight * Inflation Deviation + Weight * Output Gap.

Figure 3.8. Various Measures of the Taylor Gap in the United States



Source: IMF staff estimates.
Note: For definition of Taylor gaps, see text.

are not available for all banks in every period, the sample composition varies depending on the variable of interest. We exclude observations that are three standard deviations away from the sample mean. For each regression, the panel is balanced by keeping only banks for which data are available for every quarter over the estimation period. Results are reported in Table 3.7.

The econometric specification is the following:

$$x_{i,t} = a_1 x_{i,\,t\text{-}1} + a_2 MonetaryPolicyIndicators_t + a_3 BankSpecificFactors_{i,t} + a_4 OtherControlVariables_t + \varepsilon_{i,t}$$

where

Table 3.7. Results of the Panel Regressions

	Net Interest Margin (In percent of average earning assets)	Risk-Weighted Assets/Total Assets (In percent)	z-score	Equity Ratio (Equity/Total Assets) (In percent)	Loan Loss Provisions/Total Loans (In percent)
Lagged dependent variable	0.760***	0.868***	0.853***	0.829***	0.672***
Lagged difference (policy rate minus Taylor rate) (in percent)	0.019***	0.169	–0.717***	–0.055***	–0.012***
Number of quarters with negative Taylor gaps over the last five years	0.021	0.880***	1.293**	0.076*	–0.007
Lagged change in central bank's assets to GDP (in percent)	–0.013***	–0.058	0.251**	0.004	–0.023***
Lagged real growth	0.004	0.122**	–0.008	0.032***	–0.030***
Lagged cyclically adjusted government balance to GDP (in percent)	–0.024	–0.372**	–0.959**	–0.067*	–0.002
Lagged equity-to-total-assets ratio (in percent)	0.005	0.032			–0.004
Lagged bank size (log assets)	0.027	–0.506**	–1.308	–0.003	0.008
Global systemically important bank (dummy variable)	–0.245	1.064	8.331*	–0.528	–0.428*
Chicago Board Options Exchange Market Volatility Index (VIX)	0.00	–0.015	–0.269***	–0.001	0.004***
Number of observations	7,220	5,240	6,360	7,720	5,880
Number of banks	361	262	318	386	294
Observations per bank	20	20	20	20	20
Number of instruments	338	148	292	336	235
Sargan test (p-value)	0.31	0.53	0.26	0.19	0.29
Test for zero autocorrelation in first-differenced errors (p-value)					
Order 1	0.00	0.00	0.00	0.00	0.00
Order 2	0.94	0.13	0.38	0.46	0.00[1]

Sources: Bloomberg L.P.; Haver Analytics; SNL Financial; and IMF staff estimates.

Note: ***, **, * = statistically significant coefficients at the 1, 5, and 10 percent levels.

Risk-weighted assets are a weighted sum of a bank's assets, with weights determined by the riskiness of each asset. The z-score is the ratio of the return on assets plus the ratio of equity over total assets, divided by the standard deviation of asset returns. It is inversely related to a bank's probability of insolvency. A higher z-score is thus interpreted as lower bank risk.

The Taylor gap is the difference between the policy rate and the rate given by a standard Taylor (1993) rule. Different estimates of the Taylor gap (see text) produce different results (magnitude, sign, and significance). To reduce bias that may result from using any specific estimate of the Taylor gap, we use an average of four possible measures of the Taylor rate. Cyclically adjusted government balances are annual series from the October 2012 *Fiscal Monitor*. The coefficients on the time dummies are not reported.

Each regression is estimated using the Arellano-Bover/Blundell-Bond system generalized method of moments estimator. Instruments for the differenced equation are the second and further lags of all variables in the regression, except for the loan loss provisions ratio regression (see below). The number of lags (and hence the number of instruments) used varies according to the dependent variable and the number of banks in the sample. The first lag of the difference of each variable is used for the level equation.

[1]Because the test does not accept the null hypothesis of zero autocorrelation at order 2, we use lags three and higher as instruments in the differenced equation and the second lag of the difference of each variable for the level equation.

- $x_{i,t}$ denotes variables of bank i at time t, that is, the net interest margin, the ratio of risk-weighted assets to total assets, the z-score, the leverage ratio, and the ratio of loan loss provisions to total loans.
- $MonetaryPolicyIndicators_t$ represents Taylor rule residuals (the Taylor gap), the number of quarters during which residuals are negative over the previous five years, and the change in the ratio of central bank assets to GDP. The Taylor gap and the change in the ratio of central bank assets to GDP are lagged by one period to address endogeneity issues.
- $BankSpecificFactors_{i,t}$ corresponds to individual bank characteristics: equity ratio, log asset size, and a dummy for banks that are on the Financial Stability Board's list of global systemically important banks. Both the equity ratio and the asset size variables are lagged by one period. The regressions for leverage and the z-score do not include the equity ratio, which is used as the dependent variable in the leverage regression and is a component of the z-score.
- $OtherControlVariables_t$ comprises the real growth rate, to control for the business cycle; the ratio of the cyclically adjusted government balance to GDP (from the September 2012 Fiscal Monitor), to control for fiscal policy; and the VIX, to control for the stress in the financial system. We also include time dummies.

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