MONETARY POLICY IN TURBULENT TIMES:

IMPACT OF UNCONVENTIONAL MONETARY POLICIES

R. A. Anil Perera*

Abstract

The global financial and economic crisis warranted authorities to pursue extraordinary policy measures including fiscal stimulus and excessive monetary accommodation. Particularly, central banks in many countries resorted to conventional monetary policies exhausting the entire monetary arsenal, and they also adopted unconventional monetary policies including quantitative easing. These policies have resulted in positive impacts by way of restoring financial markets, ensuring stability in financial systems, mitigating the adverse impact of economic recession and also supporting the recovery process. However, the undue expansion in balance sheets of central banks and resultant increases in monetary bases due to the adoption of extraordinary policy measures pose several risks in different dimensions. Particularly, the continuation of such policies influences the key mandate of central banks, i.e. achieving and maintaining price stability. This study points to possible pressures on price levels due to the adoption and also the continuation of unconventional monetary policies, particularly in advanced countries. In addition, this study examines possible break down in the key channel of monetary transmission mechanism, i.e. interest rate channel during the crisis. In such context, this study suggests unwinding balance sheet expansions without delays as economies have begun to revive, credit and broad money aggregates recorded positive growth rates and price levels have commenced to pick-up. However, exit strategies need to follow a timely and gradual process. Hence, this study draws important implications for central bankers and financial market players, both in advanced and emerging countries.

Key Words: Global Financial and Economic Crisis, Unconventional Monetary Policy, Quantitative Easing, Monetary Transmission

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1. Introduction

The turbulence emerged in the United States (US) mortgage market in 2007 turned into a global financial crisis leading to a massive global economic recession. It caused the most synchronized global recession episode of the past seventy years, i.e. after the Great Depression in 1930s, as virtually all advanced economies experienced a severe recession and also many emerging and developing economies followed suit (Claessens and Kose, 2010). Initial shocks those were originated in the US markets, particularly liquidity shocks, transmitted across countries at an unprecedented pace. The entire financial landscape across the globe changed significantly due to the deterioration of confidence, collapse of many financial institutions and crunch in financial markets.

The stress in financial sector ultimately transmitted into real sectors causing severe output and welfare losses.

As a result of the crisis, the global economy experienced a negative growth in 2009 although it is now expected to record a moderate growth in 2010 driven mainly by emerging market economies [International Monetary Fund (IMF), 2010b]. Accordingly, after two years of enormous stress in international financial markets and significant deterioration in real activity across countries, the global economy has started showing signs of recovery. However, the recovery still appears to be fragile indicating that the global economy is likely to experience adverse effects of the crisis for a long period (Claessens and Kose, 2010; IMF, 2010b).

The contagion effects of the crisis warranted rapid fiscal and monetary policy responses in order to ensure orderly functioning of markets, preserve financial system stability and also to moderate adverse ramifications on output growth. As such, a number of fiscal stimuli were introduced by governments. At the same time, a range of accommodative monetary policies practiced by central banks and those have jointly contributed to the recovery process[1]. The crisis has confronted central banks with a number of questions and challenges beyond the scope of standard theory of monetary policy (Curdia and Woodford, 2010). In particular, the role of monetary policy during the crisis is subject to controversy and there remain wide-spread claims on the ineffectiveness of monetary policy during crises. For example, Christiano (2010) argues that central bank intervention in private asset markets is costly as such interventions have the potential to put the central bank independence at risk. However, other school claims that such views are wrong and also they may promote policy inaction in the face of severe contractionary shocks (Mishkin, 2009). If the imbalances in a specific financial market spill over to the entire economy, then monetary policy has a vital role to play (Boivin, 2010). Hence, in contrast, monetary policy is more potent and effective than during normal times (Bernanke, 2010; Mishkin, 2009). As such,

[1] The impact of fiscal measures during the crisis is not directly addressed in this study. However, operations of central banks to cope with the crisis can be viewed as quasi-fiscal operations (see for example: Park, 2009). Hence, balance sheet explosions in central banks indirectly capture the impact of fiscal measures.

central banks can choose to resort to their full arsenal to ease stress in credit markets and revive economic activity, mainly through pursuing a blend of conventional and unconventional[2] monetary policies. Under normal circumstances, conventional monetary policy is characterized by the setting of policy (official) interest rates of central banks.[3] More precisely, monetary policy is ordinarily considered solely in terms of the choice of an operating target for a short-term nominal interest rate (Curdia and Woodford, 2010). However, in turbulent times, unconventional monetary policies (hereafter, UMP) are expected to better serve the short-run stabilization.

At the onset of current crisis, central banks around the world intervened to prop up the liquidity conditions in financial markets by lowering interest rates, i.e. by resorting to conventional practices. These policies worked reasonably well for countries with sufficient policy space, i.e. with the level of interest rates sufficiently high at the onset of the crisis. However, as financial conditions across markets deteriorated further and with the apparent long and deep global recession, central banks were forced not only to lower their target rates in aggressive moves, but also to pursue UMP measures in large scales. This was seen as important as monetary transmission broke down in several countries (Mohanty, 2009). In countries where the level of interest rates was already low (or virtually zero), interest rate transmission mechanism was impaired by the zero lower bound (i.e. with the constraint that a nominal interest rate cannot fall below zero), requiring the use of UMP, instead of further easing of interest rates.

Following the collapse of Lehman Brothers in September 2008, a number of central banks shifted practicing UMP mainly through adopting the strategy of 'quantitative easing' (hereafter, QE).[4] Many

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[2] Unconventional monetary policy measures can take three forms, or combinations thereof: increase massively the quantity of money in circulation in the economy, known as 'quantitative easing'; influence the slope of the yield curve by committing to the future path of policy rates in order to guide economic agents' expectations and unfreeze the credit markets by directly purchasing the securities in order to exert downward pressure on risk premia, known as 'credit easing' (Banque de France, 2009).

[3] Monetary policy mainly acts by setting a target for the overnight interest rate in short-term money market and adjusting the supply of central bank money according to stipulated targets through open market operations. In order to minimize the risk exposure of the central bank's balance sheet, all liquidity-providing operations generally take place in the form of reverse transactions against a range of eligible collateral (treasury or central bank securities). As such, in normal times, central banks neither involve in direct lending to the private sector, 'the government', nor in outright purchases of government bonds, corporate debt or other types of debt instruments. By steering the level of the key interest rates, a central bank effectively manages the liquidity conditions in money markets and pursues its primary objective of maintaining price stability over the medium to long-term. This has proved to be a reliable way of providing sufficient monetary stimulus to the economy during downturns or containing inflationary pressures during upturns and also ensuring the sound functioning of money markets and hence, financial systems (Smaghi, 2009).

[4] Although markets were not operating normally during the inception of financial crisis, tensions in inter-bank markets were eased by supplementary longer-term refinancing operations of central banks. However, when the conditions changed as the crisis intensified, stress in financial markets aggravated to unprecedented levels. For example, immediately after the collapse of Lehman Brothers, the spread between the three-month Euribor and the overnight interest rate, EONIA (Euro Over Night Index Average) – which in normal times would on average be around 10 basis points – rose to an all-time high of 156 basis points on 13 October 2008. As a result of the stress, market liquidity significantly dried up. More severely, the sudden loss of confidence among market participants threatened to have adverse effects on the orderly functioning of financial markets. Under these circumstances, easing monetary policy only by lowering official interest rates was not enough. QE appeared to be the appropriate policy given the extraordinary situation in money markets.

advanced countries adopted QE along with fiscal stimulus to contain the economic downturn and strengthen confidence in financial markets. These policies have, together with conventional interest rate policies and fiscal and financial market policies of governments yielded results by way of stabilizing financial markets and overcoming the stress in financial and real sectors. Particularly, ample liquidity provision helped to avoid the meltdown in financial systems. Also, providing direct support of credit flows to borrowers and investors in disrupted markets and inducing indirect support through broadening collateral eligibility requirements have been successful in alleviating pressure and driving demand (Minegishi and Cournède, 2010).

However, the impact of UMP, particularly QE is subject to intense debate given their past experiences and related issues. Mainly, the question of the appropriate size of the central bank's balance sheet with the changes in reserves has become a key issue of the discussion agenda (Curdia and Woodford, 2010). It is argued that QE leads expansions in balance sheets of central banks due to money printing, i.e. expansion in monetary bases and hence, it can have long-term adverse ramifications, particularly on maintaining price stability. However, as per earlier experience of Japan with zero interest rate policy and QE and also with the recent experiences of US and other advanced countries, evidence on the effectiveness of UMP remains mixed (Morgan, 2009).

Baseline monetary models generally prove that there is a significant link between monetary expansion driven by central bank monetary accommodation and long-term price levels, which is consistent with the monetary theory. Particularly, sustained increases in central banks' liabilities could ultimately result in high inflation and depreciating currency. In such context, any short-term increase in central bank liabilities is required to reverse when the economy recovers as retaining such measures for a long period can have adverse implications on the functioning of financial markets as well. Although exist strategies could have negative impact in securing financial stability and economic recovery, delaying the exit could distort private incentives and also create new risks.

The focus of this study is to evaluate the impact and effectiveness of UMP commissioned during the recent crisis. Hence, this study reviews the impact of UMP and their relevance with regard to maintaining price stability objectives of central banks. There are mixed views and predictions on the movements in price levels in the period ahead. Some predict that inflation in many advanced countries to remain at subdued levels due to the under utilization of capacity and moderated commodity prices (Alexandraki and Martini, 2009; Borio and Disyatat, 2009; Chailloux, Gray, Klüh, Shimizu and Stella, 2008; Cogley, 2010; IMF, 2010b). At the same time, an elevated trend in inflation in many emerging countries is expected and also can be observed for 2010 although it is predicted to moderate in 2011 (IMF, 2010c). On the other hand, some predict possible inflationary pressures in the approaching period due to massive purchases of assets by central banks and balance sheet explosion (Belke, 2010; Bénassy-Quéré, Coeuré, Jacquet and Pisani-Ferry, 2009; Brinkhuis, 2009; Cochrane, 2009; Ellis, 2009; Garcia-Cicco, 2010; Goodfriend, 2009; Sims, 2008). Given such inconsistency and discrepancy between views and

predictions, the issue of expansionary impact of recent QE strategies of major central banks needs to be addressed based on the historical experiences and also supported by empirical investigations. In that way, the finding of this study adds knowledge in the subject area and also to support the exiting discussion on the impact of UMP measures during turbulent times.

This study points to possible pressures on price levels, particularly in advanced countries due to UMP measures practiced by central banks and resultant increases in monetary aggregates. In addition, this examines impairments in key channel of monetary transmission mechanism, i.e. interest rate channel during the crisis period. This also highlights issues related to exit strategies of UMP. The results and policy implications of this study would be useful for relevant authorities such as governments and central banks and also for financial market players in general, and the South Asian countries in particular as the reliance on UMP appears to be highly recognized in many emerging countries, particularly India[5].

This paper is structured in the following manner: Part I provides an introduction to the recent global financial and economic crisis, intervention by authorities and also a special section on the impact on the key South Asian countries. Part II reviews UMP, particularly QE based on theoretical underpinnings, their practice and recent experiences. Part III examines the impact and the effectiveness of UMP. Part IV evaluates the empirical evidence on UMP and also provides an empirical analysis. This section includes an analysis based on the findings, observations and also their implications. Part V provides a discussion on exit strategies and Part VI concludes.

Part I: Global Crisis and Policy Responses

2. Global Financial and Economic Crisis: Causes and Consequences

The global financial turmoil was occurred and propagated due to a combination of causes. Mainly, two observations suggest that financial globalization had played an important role in originating the financial crisis. First, more than half of the rise in net borrowing of the US non-financial sectors since the mid-1980s has been financed by foreign lending. Second, the collapse of the US housing and mortgage-backed-securities (MBS) markets has had worldwide effects on financial institutions and asset markets (Mendoza and Quadrini, 2010).

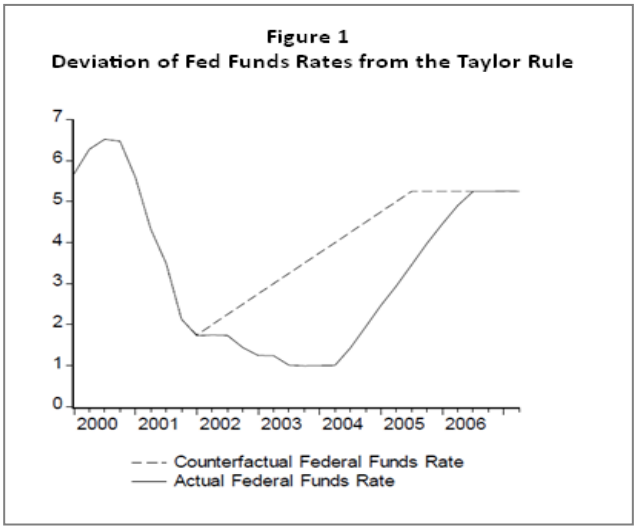
However, the crisis in the US sub-prime market was only the immediate cause of the global financial crisis and several early macroeconomic evidence hypotheses the possibility of a crisis. First, larger booms and busts in credit and asset prices, which have had followed financial liberalization since the early

[5] QE is considered as less appropriate for most emerging economies due to many reasons. First, in emerging countries, financial stress is less severe and underlying inflation higher, and hence, only few countries need to move to a near zero policy interest rate. Second, the vulnerability of emerging economies to external shocks requires that policy interest rates be kept at a level sufficient to compensate currency holders for exchange rate risk. In contrast, QE can lead to capital outflows for externally vulnerable emerging economies (Ishi, Stone and Yehoue, 2009).

1980s, caused serious financial strains. Second, many real-time indicators of financial imbalances such as unusually rapid increases in the ratio of private sector credit to GDP and in asset prices indicated possible financial stress and economic weaknesses. Third, financial imbalances had also often occurred during periods of low and stable inflation since the late 1980s–1990s like in Japan and several countries in East Asia (Borio and Disyatat, 2009).

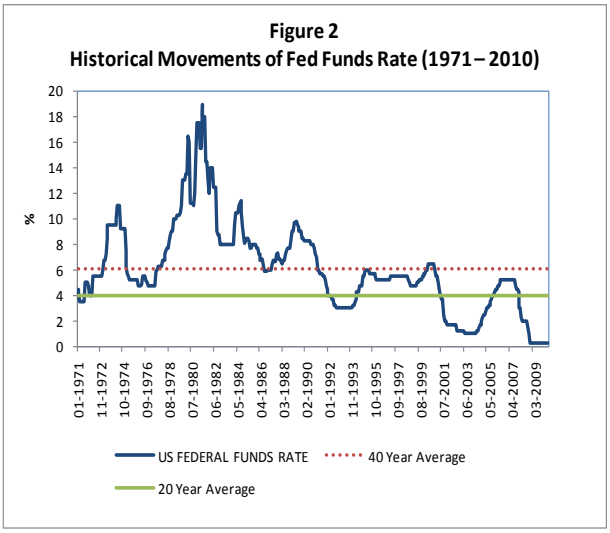
Several key aspects can be pointed as direct causes of the crisis. First, easy monetary policy had a significant impact as actual and expected low policy interest rates in developed countries helped to boost asset prices and the search for yields. The prolonged monetary excess was clearly visible through the deviations of interest rates in terms of Taylor rule (Figure 1). When examining the US Federal Reserve's (US Fed) policy decisions in terms of the Federal funds interest rate, from 2000 to 2006, it is evident that the actual interest rate decisions fell below the implied rate by the historical experience. It provides an empirical measure that monetary policy was unusually accommodative during that period. It is also observed that there was no greater or more persistent deviation of actual Fed policy since the turbulent times of the 1970s (Taylor, 2009). Therefore, it is clearly evident that there were monetary excesses during the period leading up to the housing boom. Reflecting the low interest rate environment, real house prices increased in most OECD countries and even empirical proofs show that monetary policy was a key cause of the boom and hence, the bust and ultimately, the crisis (Taylor, 2009).

Figure 1
Deviation of Fed Funds Rates from the Taylor Rule



Source: Taylor, 2007

Figure 2
Historical Movements of Fed Funds Rate (1971 – 2010)



Source: US Fed

Second, benign output growth and price levels caused in rising saving rates. Rising savings in the emerging economies and unusually low long-term risk-free real interest rates provided a conducive environment during 2003-07 for excessive risk taking in the financial sector, which ultimately contributed to the crisis. It is argued that there was an excess of global saving, which pushed interest rates down in the US and other countries (Taylor, 2009). Moreover, with frequent financial innovations

and the subsequent appearance of securitized products and derivative instruments, many market participants regarded them as a part of the 'broad liquidity' created by the shadow banking system. It was estimated that 78 per cent of broad liquidity was created by derivative instruments (9.6 times the world GDP) and it was beyond the direct control of monetary authorities (Borio and Disyatat, 2009). Such innovation allowed the market for sub-prime loans to evolve, primarily in the US, with many of the mortgage holders unable to service their debt unless house prices continued to increase. This situation ultimately caused the stress in markets.

The ailments of the crisis were amplified by several complicating factors including the use of sub-prime mortgages, especially the adjustable rate variety which led to excessive risk taking, incentives provided by government programs designed to promote home ownership, greater complexity associated with securitization and more importantly, the risks in the balance sheets of financial institutions (Taylor, 2009). As such, by early 2007, US housing prices climbed to unprecedented levels; house owners became more leveraged than they had ever been; mortgage quality declined; and asset-backed securitization (ABS) spread beyond its traditional base. Consequently, on 9 August 2007, the financial system started to crack and collapse (Cecchetti, 2008). The rapid deterioration of the US financial sector and its subsequent effects in Europe led significant weakening of the financial conditions in a number of financial institutions throughout the world. Financial institutions faced a loss of confidence and that has led to strong disturbances on inter-bank market and a severe drop in stock and commodity markets (Petrovic and Tutsch, 2009).

Central banks stepped-in in a timely manner and practiced their traditional (and statutory) role as lenders of last resort by providing liquidity directly to financial institutions. However, liquidity was not adequate to cope with the shock and frozen lending with in counterparties and compounded losses were compelled banks to sell their assets. The resulting fall in asset prices in turn further damaged the banks' balance sheets as they are naturally based on market values of assets and the continuous fall in assets prices forced banks to sell further assets. As a result, some banks faced insolvency issues, which exacerbated mistrust in the inter-bank market. The demise of Northern Rock, a UK building society, which applied for liquidity support from the Bank of England (BOE) in September 2007 and was subsequently taken into state ownership, illustrated the devastating consequences of the liquidity crisis.

The panic in financial markets heightened in September-October 2008 with the bailout of investment bank, Bear Sterns and insurer, AIG, collapse of investment bank, Lehman Brothers, and also the bailout of Dexia and Fortis, two major European banks that had complex cross-border operations. The contagion effect to the real economy amplified with the declining equity prices and the freeze of corporate bond markets retarded the ability of large companies to finance their investments. The impact was severe as banks became reluctant to lend to non-financial sectors affecting small and medium size companies. At the same time, outflow of capital from emerging and developing markets and freeze of inflows caused stress in those countries, which rely mainly on external financing. Resulting cuts in investment plans,

reduction in inventories, and contraction in world trade exacerbated the stress in real sectors. The sharp drop in previously inflated commodity prices also affected several emerging and developing countries.

Table 1

Stages of the Global Financial Crisis 2006-2009

Date	Event	Policy Response
2006-Summer 2007	Localized credit concerns in the US • Rising defaults in riskier housing mortgages • Falling prices of lower credit tiers of some credit securities	
Summer-Autumn 2007	Initial cracks in confidence and liquidity strains • Interbank rates rise sharply. Funding of asset-backed securities dries up • Failure of two large hedge funds • Run on British bank Northern Rock	• Central banks extend liquidity to banks through exceptional tenders • Rescue of Northern Rock
Autumn 2007-early Summer 2008	Accumulation of losses and continuation of liquidity strains • Severe mark-to-market losses in trading books • Collapse of commercial paper market • Structured Investment Vehicles (SIVs) brought back on bank balance sheets • Worries about liquidity of major financial institutions	Continued liquidity support by central banks • US government bails out investment bank Bear Stearns and sells it to JP Morgan
Summer 2008	Intensification of losses and liquidity strains • Mark-to-market losses and liquidity strains escalate • US agencies Fannie Mae and Freddy Mac insolvent • Funding problems of UK mortgage banks intensify	• Fannie Mae and Freddy Mac de facto nationalized in early September
September 2008	Massive loss of confidence • Bankruptcy of US investment bank Lehman Brothers • Loss of confidence that major institutions are too big to fail • Bankruptcy of Washington Mutual in the US, Bradford and Bingley in the UK, Icelandic banks • Almost total seizure of interbank money markets and short-term funding markets • Rescue of European banks Dexia and Fortis	• US government refuses to bailout investment bank Lehman Brothers. • Lehman files for bankruptcy protection. • US government bailout of insurer AIG
October 2008		Widening of collateral range and wholesale liquidity support by central banks • Governments assist banks through capital injections and funding guarantees • Explicit commitment that systemic banks will not be allowed to fail • Central banks' refinancing rates brought to zero or close to zero
Autumn 2008 - Spring 2009	Crisis transmitted to real economy • Sharp decline in industrial production and GDP • Series of financial crises in emerging Europe as	Central banks turn to unconventional policies • Large-scale government stimulus

	capital flows suddenly stop • Collapse of world trade • Slow normalization of interbank markets	• International coordination of crisis responses • International swap agreements • IMF-led assistance programmes

Source: Financial Services Authority of UK, 2009 and the modified version of Bénassy-Quéré et al, 2009

The contraction in demand in developed economies pulled the entire world into a recession, including low-income countries (Bénassy-Quéré et al, 2009). As such, as a result of the crisis, global economy underwent its deepest recessions since the Great Depression in 1930s. Many advanced countries recorded negative growth rates in output while emerging countries also expanded at moderate growth rates resulting severe employment losses and welfare losses.

3. Intervention by Authorities during the Global Crisis

The contagion effect of the crisis warranted rapid monetary and fiscal policy responses in order to ensure the orderly functioning of markets, preserve financial stability and moderate adverse ramifications on output growth. As such, governments responded swiftly to the crisis. For example, the US and Europe adopted bank rescue and guarantee plans amounting to about one-fourth of GDP. Also, governments bailed out or nationalized insolvent banks, recapitalized weak financial institutions and also provided credit guarantees to prevent further collapses. Major budgetary stimulus plans were followed by such immediate measures. In addition to these, several additional measures were also adopted. These include restrictions on dividend payments, regular reporting on business developments, restructuring requirements, government participation in banks' management, and restrictions on executive compensations. Further, government support in some cases entailed explicit targets for lending growth to maintain adequate supply of credit to the economy (for example: France, Ireland, and the UK) (Stolz and Wedow, 2010). Many countries increased the coverage of deposit insurance schemes and moved away from co-insurance activity while injecting capital. Typically, measures have been implemented by ministries of finance, however, with the involvement of the monetary and/or the supervisory authority. The IMF, the World Bank, regional development banks and other donor institutions also acted to counter capital outflows from emerging economies, to finance international trade and also to help developing economies to introduce countercyclical policies (Bénassy-Quéré et al, 2009).

Generally, central banks are expected to pursue their conventional function that mainly focuses on maintaining price stability and in some cases, financial system stability, which both are important for creating a conducive environment for smooth functioning and the expansion of the economy. However, in extraordinary times, central banks are expected to move beyond the traditional mandates. Particularly, in turbulent times, central banks are expected to support the financial system and the economy (Mishkin, 2009). Based on this premise, during the recent crisis, many central banks acted to ease the stress in credit markets and to revive economic activity, mainly through pursuing a blend of conventional and unconventional monetary policies.

Central banks first responded to the emerging crisis through injecting liquidity into financial systems. At the early stages of the crisis, the provision of liquidity was paramount to support banks as liquidity in markets substantially dried up. In response to the intensification of the crisis, central banks additionally adopted various measures to enhance liquidity provision to banks, which can be broadly divided into traditional and nonstandard categories (Stolz and Wedow, 2010). As traditional measures, central banks had already lowered policy interest rates in view of the rapid deterioration in the financial market conditions and the macroeconomic environment. This was facilitated by the already changing outlook for price stability as inflation risks were declining and deflation risks were emerging particularly in advanced economies. However, as such measures proved insufficient to reduce pressures and the widening spread between overnight and term inter-bank rates, central banks opted to implement changes to their operational frameworks.

Table 2

Monetary Policy Measures in Selected Countries

Country	Start Date of Monetary Policy Measures	Policy Rate at the Onset of Monetary Relaxing (%)	Lowest Level of Policy Rate (%)
USA	September 2007	5.25	0-0.25
Euro Zone	October 2008	4.25	1.25
Japan	October 2008	0.50	0.10
UK	December 2007	5.75	0.50
Australia	September 2008	7.25	3.00
South Korea	October 2008	5.30	2.00
China	September 2008	7.47	5.30
India	October 2008	9.00	4.75

Source: Respective Central Banks and Thomson Reuters Datastream

Following the collapse of Lehman Brothers, many central banks shifted to UMP strategies, which include: more frequent auctions; expansions of the volume of lending facilities; longer-term financing ; changes in the auctioning process; broadening of the range of accepted collateral; outright asset purchases and the setting up of liquidity facilities for intermediaries other than banks. While pursuing UMP measures, many central banks including the BOE, the European Central Bank (ECB), and the Bank of Japan (BOJ) purchased huge quantities of government and corporate bonds and also intervened in foreign exchange markets in order to boost liquidity. However, the approach of the US Fed has been more specific. The Fed significantly expanded its balance sheet through 'credit easing'[6] measures designed to intervene aggressively in the credit products market and related markets. For example, the Fed decided

[6] The Fed Chairman, Ben Bernanke called this as a 'credit easing' programme (Bernanke, 2009).

to buy up to US dollars 300 billion of longer-term treasuries and expand an existing programme to buy debt and MBSs issued by Fannie Mae, Freddie Mac and other agencies by US dollars 850 billion to US dollars 1.45 trillion. These purchases were meant to drive down long-term interest rates, including mortgage rates. In addition, there were other programmes to purchase other types of debts with the aim of bringing down borrowing costs in specific sectors[7]. In addition, different types of UMP measures were used by many other central banks including Australia, Korea, Singapore, Taipei, India and China (Section 7 provides a detailed discussion on the UMP during recent times).

Table 3

The Expanding Role of Central Banks during Recent Times

<table>
<tr><th>Conventional Policies</th><th>Monetary Policy Tools</th><th>Prudential Policy Tools</th></tr>
<tr><td>• Focus on prices
• Indirect approach to influencing financial conditions and asset prices
• Direct influence on the very short-term interbank market only</td><td>• Policy interest rates
• Reserve requirements/ cash reserve ratios</td><td>• Capital requirements
• Liquidity requirements</td></tr>
<tr><th rowspan="2">Unconventional Policies</th><th colspan="2">Central Bank Balance Sheet Tools</th></tr>
<tr><th>Intervention in Domestic Financial Markets</th><th>Intervention in Foreign Exchange Markets</th></tr>
<tr><td>• Focus shifted from prices to quantities
• Direct intervention in financial markets</td><td>• Term interbank market
• Sovereign bond markets
• Credit markets (corporate and covered bonds, asset backed securities)
• Mortgage markets</td><td>• Foreign exchange intervention
• Reserve accumulation
• Currency swap arrangements</td></tr>
</table>

Extracted from Hannoun, 2010 and modified by the author

While these efforts undertaken by central banks are reflected by the expansions of their balance sheets (Stolz and Wedow, 2010), the impact of such measures can be attributed to the gradual recovery of the global economy. As such, the global recovery is proceeding better and earlier than expected although varying speeds. Particularly, many advanced economies recover at a slower pace and most emerging and developing economies recover at a solid pace. In this context, in 2010, world output is expected to rise by about 4.5 per cent and 4.25 per cent in 2011 following the contraction in 2009 (IMF, 2010c). At the same time, risks to global financial stability have eased. For example, as per the estimates of IMF, write-downs of banking system in the economies have been reduced to US dollars 2.3 trillion in 2010 from US dollars 2.8 trillion in October 2009 (IMF, 2010b).

[7] The most important difference between Europe and the US is the fact that the Fed has been supporting individual institutions, while the ECB's and the BOE's role has been limited to liquidity extension (Hannoun, 2010).

4. Impact of the Crisis on India, Sri Lanka and Pakistan and Responses

The impact of the global crisis on major South Asian economies namely, India, Sri Lanka and Pakistan can be observed mainly through losses on output and run-down in external reserves and also through the widened fiscal deficits. The responses to the crisis, in general, can be viewed through lowered policy interest rates, reduced reserve requirements, extended liquidity facilities and also through fiscal stimulus.

The initial impact of the sub-prime crisis on the Indian economy was rather insignificant and even, following the cuts in the US Fed funds rate in August 2007, there was a massive increase in net capital inflows. Reserve Bank of India (RBI) involved in sterilizing the liquidity impact of large foreign exchange purchases through a series of increases in the cash reserve ratio and issuances under the Market Stabilization Scheme. Therefore, the direct effect of the sub-prime crisis on Indian banks and financial sector was negligible mainly due to the limited exposure to complex and toxic derivatives and other prudential policies introduced by the RBI (Mohan, 2009). However, following the Lehman failure, there was a sell-off in domestic equity markets and also large capital outflow causing pressures in the foreign exchange market. Although foreign direct investment flows exhibited resilience, access to external commercial borrowings and trade credit was difficult. As a result, net capital inflows were lower in 2008 and there was a depletion of reserves. At the same time, fiscal conditions came under renewed pressure due to higher expenditure and the fiscal stimulus packages and also due to tax cuts. Reflecting the slowdown in external demand, and the consequences of reversal of capital flows, output growth also decelerated although the financial sector was broadly resilient (Mohan, 2009).

Recognizing the depth and extraordinary impact of the crisis, the Indian government relaxed its fiscal targets and launched two fiscal stimulus packages in December 2008 and January 2009. These packages included additional public spending, particularly capital expenditure, government guaranteed funds for infrastructure spending, cuts in indirect taxes, expanded guarantee cover for credit to micro and small enterprises, and also additional support to exporters. Meanwhile, the RBI's response was aimed at containing the contagion effects in order to secure the domestic money and credit markets and hence, it pursued both conventional and unconventional measures. On the conventional side, the RBI reduced its policy interest rates aggressively, reduced the quantum of bank reserves impounded by the RBI and expanded and liberalized refinance facilities for export credit, adjusted upwards the interest rate ceiling on the foreign currency deposits by non-residents, relaxed the external commercial borrowings regime for corporates, and also allowed non-banking financial and housing finance companies to access foreign borrowing. UMP measures included a rupee-dollar swap facility for Indian banks to support short-term foreign funding requirements, an exclusive refinance window as a special purpose vehicle for supporting non-banking financial companies, and expanding the resources available to apex finance institutions for refinancing credit extended to small industries, housing and exports. These measures helped to ensure orderly functioning of financial markets and arrest the moderation in economic growth (Subbarao, 2009).

Although the RBI's balance sheet did not show unusual expansions, sharp reductions in cash reserve ratio raised the money multiplier leading to higher increase in broad money (Mohanty, 2009).

Table 4

Key Economic Indicators in Key South Asian Countries (2007 – 2009)

Indicator	India			Sri Lanka			Pakistan		
	2007	2008	2009	2007	2008	2009	2007	2008	2009
Economic Growth (%)	9.0	6.4	5.7	6.8	6.0	3.5	6.8	4.1	2.0
Inflation (Avg. %)	5.4	4.8	8.3	15.8	22.6	3.4	7.8	12.0	20.8
Budget Deficit (%of GDP)	-7.4	-7.3	-6.8	-6.9	-7.0	-9.8	-4.4	-7.6	-4.4
Official External Reserves (Month of Imports)	14.8	10.5	11.7	3.7	2.0	6.3	7.7	4.2	5.1
Exchange Rate (Rs./US dollar)	41.29	43.42	46.54	110.62	108.33	114.94	60.65	62.68	78.65
Base Money Growth (%)	20.4	27.5	16.1	10.2	1.5	13.1	20.9	22.3	1.9
Broad Money Growth (%)	20.5	22.1	20.4	16.5	8.5	18.6	19.3	15.3	9.6

Source: Annual Reports and Web-sites of CBSL, RBI and SBP and IMF

Sri Lankan economy was also not affected by the initial waves of the financial crisis. Although Sri Lanka was running high current account deficits, indicating the resilience, inflows to the capital and financial accounts were more than sufficient to offset deficits during the first nine months of 2008. However, with the intensification of the crisis, Sri Lanka also faced sudden withdrawals of foreign capital by supplying almost 50 per cent of external official reserves. Also, lower export growth and remittances performance affected the external earnings. Consequently, Sri Lanka's external position ended up with balance of payments deficit of US dollars 1.2 billion in 2008. The twin shocks (global food and energy crises) and the intensification of the global financial crisis affected government's fiscal performance and hence, the government opted to rely more on domestic borrowings to finance the budget deficit in the midst of the tight liquidity situation in the international financial markets. The adverse external environment and lower external demand impacted country's output growth. However, the financial sector was resilient as prudential safeguards were in place and financial institutions were not exposed to toxic assets [Central Bank of Sri Lanka (CBSL), 2008].

The CBSL adopted several measures to mitigate the adverse impact of the crisis on the domestic financial market. Several measures were taken to boost foreign currency inflows including the arrangement of special funding lines with other countries, promoting investments in government securities among Sri Lankan diaspora and migrant workers and obtaining a Stand-by Arrangement (SBA) facility from the IMF to rebuild the international reserve position with a view to safeguard the country for external shocks. On the other hand, the CBSL reduced statutory reserve ratio on domestic deposits to provide more liquidity into the banking system while adjusting policy interest rates downwards. At the

same time, the government introduced a stimulus package to assist affected parties particularly, exporters.

Table 5

Fiscal and Monetary Policy Measures in Key South Asian Countries (2007-2010)

Policy	India	Sri Lanka	Pakistan
Fiscal	Introduced a fiscal stimulus package in 2008 (3.4 per cent of GDP), increased the package in 2009 (4.25 per cent GDP) and continued in 2010 (2.5 per cent GDP) as well.	Announced a stimulus package of Rs. 1.6 billion to assist mainly the export oriented industries. The package included the reduction in the fuel prices and removal of the Fuel Adjustment Levy charged for tourist hotels and industries and implementation of subsidy schemes for manufacturers engaged in the rubber industry.	Provided stimuli in order to boost economic activity. As a result of the targeted stimuli, development expenditure increased to 3.8 per cent of GDP in 2009-10 and further to 4.7 per cent for 2010-11.
Monetary	Reduced cash reserve ratio by and repo rate by 4 per cent and reverse repo rate by 2.5 per cent during 2008-2009 although there were upward adjustments in 2010.	Reduced statutory reserve ratio by 3 per cent, repo rate by 3.25 per cent and reverse repo rate by 2.5 per cent during 2007-2010.	Reduced cash reserve ratio by 2 per cent, repo rate by 0.5 per cent, and reverse repo rate by 2 per cent during 2007 - 2009.

* In addition to these measures both Sri Lanka and Pakistan obtained facilities from the IMF.

Source: Ali, 2009; Rajaraman, 2010; Bloomberg; IMF ; Annual Reports of CBSL, RBI and SBP

At the onset of the crisis, Pakistan was facing a rapidly deteriorating macroeconomic environment due to the confluence of the international commodity price shock and also national political and security issues. Also, sustained increases in inflationary pressures, both fiscal and current account deficits, which were at record highs created significant imbalances. In this context, Pakistan implemented a macroeconomic stabilization programme with the support of the IMF from November 2008. Economic fundamentals, however, deteriorated further in the first half of 2009 and there were liquidity strains in banking sector and the money market. By then, the second round impact of the global crisis had also hit the economy through the contagion channels of trade and capital flows. The imbalances were financed at the expense of foreign exchange reserves and consequently, sovereign ratings were revised downward by Moody's in October 2009 resulting a drying up of capital flows. All these developments together had an adverse impact on the output growth [State Bank of Pakistan (SBP), 2008].

The SBP was adopting a tight monetary policy stance to arrest inflationary pressure since 2008, and continued the same into 2009 as well. However, faced with a liquidity stress in the money market, SBP lowered reserve requirements releasing liquidity in the market. Although the liquidity easing measure diluted the impact of monetary tightening to a certain extent, inflationary pressures started to ease off to

a certain extent. This allowed SBP to change the policy direction, and hence, it was able to reduce policy rates to support the economic activity (SBP, 2009).

Part II: Unconventional Monetary Policies

5. Conceptual Background

During normal times, central banks prefer to use an interest rate rather than the monetary quantity as the operating target, because interest rates are much easier to observe and control on a continuous basis than monetary quantities. However, during extraordinary times, conventional monetary policy tools may prove insufficient to achieve the central bank's objective due to two reasons. First, although the economic shock requires that the nominal interest rate needs to be brought down to zero, it may not be possible since the nominal interest rate cannot be lowered below zero. In such situation, further cuts in policy rates would not be possible, and hence, any additional monetary stimulus can be undertaken by resorting to UMP tools. In particular, the additional monetary stimulus at the zero lower bound policy interest rate can be achieved in three complementary ways by (i) guiding medium to long-term interest rate expectations, (ii) changing the composition of the central bank's balance sheet, and (iii) expanding the size of the central bank's balance sheet. These measures are designed to improve financial conditions beyond the short-term inter-bank interest rates. Second, UMP may be warranted even when the policy interest rate is above zero if the monetary transmission process is significantly impaired. Hence, when nominal policy interest rate is constrained by the zero lower bound, a central bank is required to rely on 'non-standard' policy alternatives as it can no longer stimulate aggregate demand by further reductions in interest rates (Bernanke, Reinhart and Sack, 2004).

Bernanke and Reinhart (2004) consider two types of policy options under zero lower bound constraints of nominal interest rates; (i) changing the composition and size of the central bank balance sheet, and (ii) altering market expectations about the future course of short-term interest rates. Focusing on the expectation channel, a central bank can produce further easing effects by a policy commitment, even when short-term interest rates decline to virtually zero. As such, a central bank can influence market expectations by making an explicit commitment to the duration for which it will hold short-term interest rates at virtually zero and hence, it can reduce longer-term interest rates. However, many central banks choose UMP without making a clear commitment to the future path of monetary policy as evident in the current crisis as well.

During unusual times, when nominal rates are stuck at zero, the quantity of base money remains available as a tool for gauging the extent of monetary easing (Orphanides and Wieland, 2000). Thus, monetary policy operations can be shifted to the quantity of base money provided when overnight policy rates hover near zero. As such, the central bank can steer the overall magnitude of real balances in the

economy by providing more base money and hence, can exert an influence on aggregate demand and inflation by exploiting real balances and portfolio balance effects.

A systematic interest rate policy similar to Taylor's rule can be used to illustrate the procedure of shifting the central bank's operating target from a policy rate to a monetary quantity (Wieland, 2009):

$$i_t = r^* + \pi_t + \alpha_\pi (\pi_t - \pi^*) - \alpha_y (y_t - y_t^*) \qquad (1)$$

where i_t stands for the policy rate in period t, $\pi_t$and π^* refer to the current rate of inflation and the inflation target, respectively, while $y_t$and y_t^* denote current and potential output, respectively. r^* represents the long-run equilibrium real interest rate.

A central bank raises or lowers the nominal interest rate in response to deviations of inflation from its target and output from the potential. The extent of the policy response is governed by the coefficients α_π and α_y. To achieve the operating target for the policy rate defined by equation (1), the central bank conducts open market operations (OMO). These operations also influence the quantity of base money. Thus, in principle, the interest rate equation could be related to a policy prescription for the quantity of base money or a measure such as the Marshallian k [8].The relationship of this ratio to the inflation and output gaps may then be described as follows:

$$\frac{Base\ Money}{Nominal\ Income} = k_t = k^* + \kappa_\pi(\pi_t - \pi^*) - \kappa_y(y_t - y_t^*) \qquad (2)$$

Here, κ_π and κ_y constitute parameters governing the responsiveness of the Marshallian k that are consistent with the response coefficients in the interest rate rule. When the interest rate is stuck at zero, equation (2) can still provide guidance for policy. Orphanides and Wieland (2000) show that the optimal policy response is nonlinear, because the effectiveness of policy is reduced with near zero interest rates. Thus, optimal values of κ_π and κ_y are much bigger in a situation where the interest rate is near zero than in normal circumstances. The optimal policy expressed in base money exhibits a kink when the interest rate reaches zero as it provides a motivation for more aggressive expansion of the central bank balance sheet.

As per Bernanke et al (2004), at least there are three channels through which UMP, particularly QE may be effective. First, it is associated with the premise that money and other financial assets are imperfect substitutes. According to the imperfect substitutes view, increases in money supply induce households and firms to rebalance their portfolios by trading money for non-money assets. As the private sector collectively cannot change its asset holdings, attempts to rebalance portfolios will tend to raise prices and also lower the yields of non-money assets if money and non-money assets are imperfect

[8] Marshallian *k* puts the quantity of nominal money into perspective relative to nominal income (Wieland, 2009).

substitutes. Accordingly, higher asset values and lower yields in turn would stimulate the economy. The second possible channel is the fiscal channel. This channel relies on the observation that sufficiently large monetary injections will materially relieve the government's budget constraint, permitting tax reductions or increases in government spending without increasing public holdings of government debt. The third potential channel of QE is the signalling channel. QE may complement the expectations management approach by providing a visible signal to the public about the central bank's intended future policies (Bernanke et al, 2004).

Table 6

Policy Options Near the Zero Lower Bound on Nominal Interest Rate

Strategy I	Managing expectations about future levels of the policy rates
Intended Effect	Affecting the prevailing medium and long-term rates
Strategy II	Targeted asset purchases (may include lending against non-traditional assets)
Intended Effect	Changing asset prices due to the changes in relative asset supplies Reducing liquidity premiums in dysfunctional markets
Strategy III	Quantitative easing (expansion of central bank balance sheet to generate excess reserves)
Intended Effect	Rebalancing portfolios by investors Possibly affecting inflation expectations

Source: Extracted from Ueda, 2009

During a financial and economic crisis, both asset and liability sides of the central bank balance sheet play an important role in countering the adverse effects on the financial system. Hence, UMP measures directly relate to the balance sheet of central banks, particularly, the size and the composition. The asset side works as a substitute for private financial intermediation, for example, through the outright purchase of credit products. The liability side, especially expanded excess reserves, acts as a buffer for funding liquidity risk in the money markets. In addition, the two sides interact closely, since failures in financial intermediation are closely tied to funding liquidity risk at financial institutions, resulting in the increased demand for excess reserves. In practice, given the constraints on policy implementation, central banks combine the two elements of their balance sheet, size and composition, in order to enhance the overall effects of UMP.

This raises several policy implications on the determinants of the size and the composition of the central bank's balance sheet. First, QE, which is a package of UMP, is involved in both the asset and liability sides of the central bank balance sheet and it is designed to absorb the shocks hitting the economy. Second, QE is a temporary policy response. The increase in the size and the change in the composition of the central bank balance sheet remains until certain progress will be made in balance sheet adjustments of financial institutions, such as disposal of non-performing assets and recapitalization. Third, QE is likely to produce side-effects. A massive expansion of the central bank balance sheet is a consequence of public intervention (or it is a quasi-fiscal operation) in private financial transactions, and

hence, that can potentially distort incentives and resource allocation in the private sector. In particular, such side-effects become more obvious when QE prolongs for a long period. In that sense, a cost-benefit comparison of UMP depends crucially on the length of time for which such intervention is needed (Shiratsuka, 2009).

6. Different Types of Practice

As already mentioned, UMP can be implemented by combining two elements of the central bank balance sheet, i.e. the size and the composition. The size corresponds to expanding the balance sheet, while keeping the composition unchanged (narrowly-defined QE). Also, UMP can use both the asset and liability sides of the central bank balance sheet to absorb the shocks affecting the economy (broadly-defined QE). The composition corresponds to changing the structure of the balance sheet, while keeping the size unchanged by replacing conventional assets with unconventional assets, i.e. narrowly-defined credit easing (Shiratsuka, 2009).

Accordingly, the alteration of the size and the composition of the central bank balance sheet through UMP measures can be in various forms such as 'direct quantitative easing', 'direct credit easing' and 'indirect (or endogenous) quantitative/credit easing':

Direct Quantitative Easing: QE occurs when a central bank focuses less on the price of money, i.e. interest rate than the quantity of money. In other words, QE occurs when a central bank refrains focusing on an interest rate target, but directs its efforts towards providing a higher level of liquidity in the banking system. In contrast to OMO conducted through repurchase agreements, which tend only to change the size of the balance sheet temporarily, central banks pursue QE in the last resort, after exhausting other monetary easing tools. Hence, in simple, QE is injecting money directly into the economy (BOE, 2009). It has been traditionally focusing on buying longer-term government bonds from banks with a view to bring down the yields on privately issued securities in parallel with those on government bonds. Resulting declines in long-term interest rates support to stimulate longer-term investments and hence, aggregate demand, thereby supporting price stability. If central banks need to ensure flow of new loans to the private sector, then they mainly purchase bonds from the banks and the additional liquidity created by such operations would then be used by the banks to extend new credit. However, in some cases, banks may choose to hold the liquidity received in exchange for the bonds in their reserves at the central bank as a buffer. In such context, the liquidity provided by the central bank remains within the banking sector without flowing out into the broad financial sector and the real economy. Such risks can be minimised if the central banks rely on these types of operations only at the lower bound of interest rates or in other words, when it has fully exploited the standard interest rate channel. At the lower bound, the remuneration of deposits is null and there is

hence, insignificant (or almost no) incentive for banks to park excess reserves with the central bank. Generally, deploying QE at a policy rate, which is above the lower bound, increases the risk exposure of the central bank, in addition to the larger expansion of its balance sheet. QE is successful if it is able to narrow the market spreads between the rates paid on selected credit instruments and policy rates, thereby limiting the risks of a liquidity shortfall and encouraging banks to extend credit to other types of borrowers.

Table 7

Difference between OMO and QE

	OMO	**QE**
Timing	Conducted regularly	The ultimate tool of central banks, pursued when official rates are at, or near, zero
Policy Tools	Buy/sell short-term government securities	Buy longer dated government bonds and private securities
Objective	Influence overnight interest rates to converge with the policy rates	Bring down longer dated interest rates
Impact on Central Bank Balance Sheet	Affects central bank balance sheet temporarily	Increases central banks' balance sheet permanently

Source: Extracted from Yim, 2009 and modified by the author

Direct Credit Easing: This directly addresses liquidity shortages and spreads in certain market segments through the purchases of commercial papers, corporate bonds and ABSs. The effectiveness of such measures, which aimed at wholesale financial markets, depends on their significance in financing of households and firms. It is considered as a more attractive strategy in times of acute bank distress. Buying privately issued securities implies that the central bank interacts directly with the private sector. However, buying privately issued securities do not fundamentally differ from buying government bonds in terms of the impact on monetary base or money supply. Also, outright purchases of privately issued securities affect the risk profile of the central bank's balance sheet.

Indirect (Endogenous) Quantitative/Credit Easing: Direct QE or credit easing relates to direct acquisition of the assets by the central bank, in exchange for central bank money. This implies that the central bank directly holds assets, until maturity or resale, and thus faces the risk on its balance sheet. An alternative way to increase the size of the balance sheet is lending to banks at longer maturities, against collateral, which include assets whose markets are temporarily impaired. This policy affects directly the yield curve over the horizon at which policy operations are conducted or committed to be conducted. For example, monetary policy operations with maturity of 6 months would directly affect the 6-months interbank money market. The horizon of the yield curve, which is affected, may be lengthened to the extent that the central bank commits to conduct such type of tenders for a given period of time. The increase in the monetary base is determined endogenously by the banking system, based on banks' preference for liquidity.

7. The Global Crisis and the Use of Unconventional Monetary Policies

a. Advanced Countries

As the financial crisis intensified, reactions of central banks were unprecedented in both speed and scope (Minegishi and Cournède, 2010). Also, in nature, such reactions were common for many advanced and some emerging countries.

Monetary policy measures taken in advanced countries in response to the crisis can be broadly categorised into five elements: lowering policy rates to very low levels, increasing liquidity provision to financial institutions, intervening directly in wider segments of the financial market, purchasing long-term government bonds, and supporting specific institutions (Minegishi and Cournède, 2010).

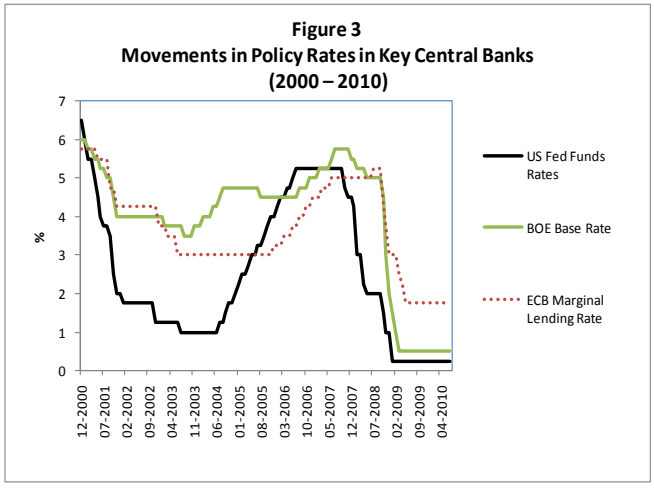
Table 8

Measures taken by Major Central Banks in Response to the Crisis

Measure	Fed	BOE	ECB	BOJ
Lowering policy rates to very low levels	√	√	De facto	√
Increasing liquidity provision to financial institutions	√	√	√	√
Intervening directly in wider segments of the financial market	√	√	√	√
Purchasing long-term government bonds	√	√	√	√
Supporting specific institutions	√	√		√

Note: In addition, many central banks in advanced economies such as Bank of Canada, Swedish Riksbank, Swiss National Bank, and Reserve Bank of Australia adopted several similar measures.

Lowering Policy Rates to Very Low Levels*:* As already mentioned central banks stepped in to mitigate the impact of the crisis, initially by lowering of policy interest rates.



Source: Thomson Reuters Datastream

Increasing Liquidity Provision to Financial Institutions: Exceptionally low policy interest rates were expected to lower funding cost for banks supporting economic activity through reduced lending

rates. Money markets, however, became dysfunctional with the dawn of the crisis. Due to the looming uncertainty over liquidity needs and counterparty risk, money market interest rates rose substantially relative to risk-free rates. Although many banks hoarding liquidity, the transaction volume in the market diminished considerably. Also, the turmoil in the money market impaired the interest rate channel of the monetary transmission mechanism (Minegishi and Cournède, 2010). In reaction to the freeze in interbank markets, central banks undertook numerous initiatives to ease funding conditions involving modification to the pre-existing facilities and introducing new schemes. Many central banks commenced providing liquidity while keeping policy target rates in the positive territory. The objective was to meet the increased demand for liquidity, and measures taken by central banks in this regard exhibit a number of common characteristics such as relaxation/elimination of caps in liquidity offers, relaxation of collateral eligibility requirements, expansion of the list of counterparties, provision of longer-term liquidity, and provision of liquidity in foreign currency. For example, the Fed introduced a Term Auction Facility (TAF) and the Primary Dealer Credit Facility (PDCF) and entered into foreign exchange swap programmes with other central banks; the ECB extended the timing and maturity of liquidity provision, introduced supplementary refinancing operations, and conducted OMO at fixed rates with full allotment. These measures, together with the direct market intervention schemes, resulted in greater liquidity provision to keep effective market rates in line with policy rates, and thereby generating a significant downward pressure on market rates.

Intervening Directly in Wider Segments of the Financial Market*:* In addition to money markets, many segments of financial markets have been severely affected by the crisis. Both new issuance in primary markets and trading in the secondary markets have suffered from lower transaction volume and hence, less liquidity. In this context, central banks intervened in a targeted manner to improve conditions in credit markets, in order to avoid further economic disruption. As some markets remained impaired, central banks embarked on more explicit support by way of direct interventions including outright asset purchases aimed at boosting market sentiment, increasing liquidity and boosting prices (or equivalently lowering yields). Given the importance of capital market funding to the US economy, the Fed has been the most active in this regard. Programmes initiated by the Fed were in the form of lending to buyers of the financial instruments. Even in such cases, the effects can be considered to be broadly similar to outright purchases. Many other central banks have also decided to purchase outright various categories of private sector assets, although their interventions have generally been relatively smaller compared with that of the Fed (Minegishi and Cournède, 2010).

Table 9

Quantity/ Credit Easing Measures taken by Major Central Banks

Objective	Measures adopted	Fed	ECB	BOE	BOJ
Influence wholesale interbank market conditions	Modification of discount window facility	√		√	
	Exceptional long-term operations	√	√	√	√
	Broadening of eligible collateral	√	√	√	√
	Broadening of counterparties	√		√	√
	Inter-central bank foreign exchange swap lines	√	√	√	√
	Introducing or easing conditions for securities lending	√		√	√
Influence credit markets	Commercial paper funding/purchase/collateral eligibility	√		√	√
	Asset-backed securities funding/purchase/collateral eligibility	√	√	√	
	Corporate bond funding/purchase/collateral eligibility			√	√
Influence broader financial conditions	Outright purchase of public sector securities	√	√	√	√
	Outright purchase of other non public-sector securities	√			√

Source: Morgan, 2009; Bean et al. 2010

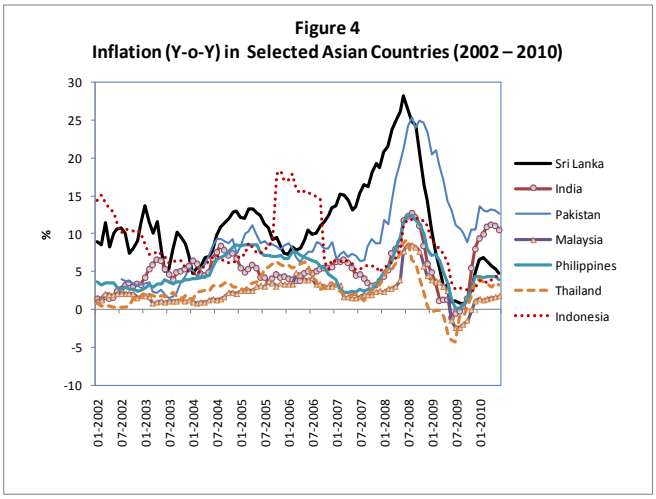
Purchasing Long-Term Government Bonds*:* Some central banks, mainly BOJ, Fed and BOE increased or introduced outright purchase of long-term government bonds with a view to facilitating liquidity provision over longer-term horizons. For example, BOJ increased the monthly pace of purchase from the pre-crisis level of 1.2 trillion yen (equivalent to 0.23 per cent of GDP) eventually to 1.8 trillion yen (0.35 per cent of GDP). The Fed also purchased US dollars 300 billion (equivalent to 2.1 per cent of GDP) of long-term treasury securities in order to lower the risk-free rate over the medium to long-term. The QE policy of the BOE that aimed at expanding base money as rapidly as possible was conducted through the Asset Purchase Facility whose asset size was extended from the initial Sterling pound 75 billion (5.4 per cent of GDP) to Sterling pound 200 billion (14.3 per cent of GDP), largely comprised of holdings of gilts. However, these central banks refrained from purchasing government bonds in the primary market, to avoid fuelling fears that they might monetise fiscal deficits (Minegishi and Cournède, 2010).

Supporting Specific Institutions: Some central banks such as the Fed, BOE, Riksbank and Swiss National Bank (SNB) engaged in emergency liquidity provisions to individual financial institutions by increasing the scope of the lender of last resort function and the usual criteria regarding the quality of the collateral.

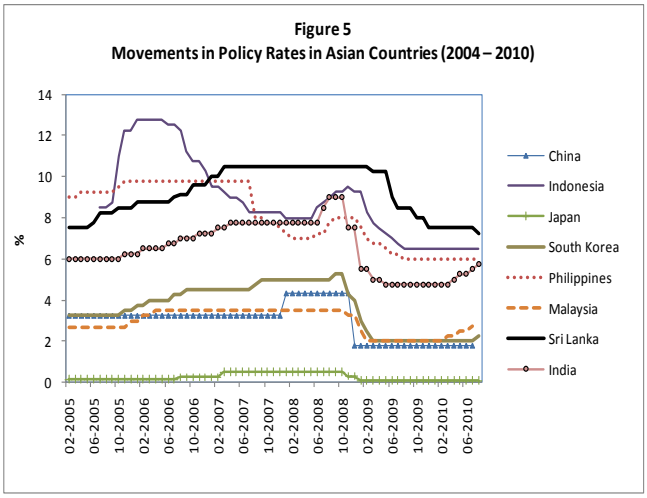
While the Fed, BOE, ECB and BOJ were pursuing a range of UMP measures, Australia also swiftly responded to the crisis. As the Australian government had run budget surpluses for many years, and had paid-off all government debt, it engaged in a large fiscal expansion during the crisis contributing to an effective fiscal easing (Battellino, 2010). Although the Reserve Bank of Australia (RBA) did not engage in any credit easing policies, the Australian government undertook two initiatives that can be considered as credit easing policies; first, setting up a small fund to provide financing to car dealerships after some vehicle financing companies withdrew from the market; and second, buying a small amount of MBSs to help maintaining the flow of new securitizations. Hence, credit exposure on RBA balance sheet did not changed significantly.

b. Emerging/Developing Countries

The turbulent conditions in advanced economies elevated the stress across emerging and developing economies above levels seen during the Asian crisis, but with significant cross-country variations (Balakrishnan, Danninger, Elekdag and Tytell, 2009). This warranted the central banks of those countries to adopt required measures in order to safeguard financial systems and also to mitigate the contagion effects on real economy. For example, some countries in Asia were adopting substantially tight monetary policies at the onset of the global crisis. The sub-prime crisis had modest impact on these economies, and major concerns were the inflationary consequences of overheating economies and rising commodity prices (IMF, 2009). From about September 2008, however, many economies in the region began to adopt monetary easing policies. The economies with considerable space for easing aggressively reduced policy interest rates in several steps over the subsequent months. As a result, market interest rates in many countries in Asia converged to extremely low levels during the early months of 2009.



Source: Thomson Reuters Datastream



Source: Thomson Reuters Datastream

The UMP measures undertaken by emerging economy central banks can be categorized into three broad categories; direct liquidity easing measures, foreign exchange easing measures and credit and quantitative easing measures (Ishi, Stone and Yehoue, 2009).

Direct Liquidity Easing Measures: Three types of measures were used in this regard. First, direct instruments in money markets (cuts in reserve requirement ratios, introduction of reserve averaging, and increases in exemption thresholds) were used to alleviate domestic liquidity shortages. For example, after reducing interest rates and reserve requirements in the latter part of 2008, Peoples' Bank of China (PBC) removed limits on credit growth, which led to an extraordinary expansion of bank lending. In most cases, relaxing reserve requirements was not accompanied by cuts in policy interest rates implying that central banks were only aiming at easing liquidity rather than changing monetary policy stance. Second, systemic domestic liquidity arrangements were commonly used. Many central banks eased the terms of existing standing and market-based liquidity providing facilities (extending maturities, lowering collateral haircuts, increasing frequency of auctions). Also, eligible collaterals were broadened considerably. Several central banks provided domestic liquidity to targeted institutions. Third, in a few cases, governments also actively involved in providing liquidity, including by shifting government deposits into banks for distribution to others, deferring tax payments, and auctioning government securities to banks.

***Foreign Exchange Easing Measures*:** Two types of measures were used. First, many central banks eased the terms of existing foreign exchange facilities (extending maturities, broadening collateral, etc.) and introduced new foreign exchange liquidity facilities, such as dollar repo and swap facilities. Counterparties were widened, to include nonbank financial institutions and key non-financial institutions (e.g., exporters or energy importers). Foreign exchange liquidity limits were relaxed, including removing the ceilings on bank purchases of offshore foreign exchange and easing capital

inflow limits. A few governments transferred foreign currency deposits held overseas to domestic banks, guaranteed foreign exchange liabilities of banks and exporters, and lowered taxes on foreign exchange transactions. Furthermore, some central banks lowered the required reserve ratio for bank foreign currency liabilities and shifted the currency structure of required reserves away from foreign exchange. Second, cross-central bank currency swap arrangements were used. For example, the Fed established dollar swap arrangements with central banks in Brazil, Korea, Mexico, and Singapore, while the ECB and the SNB each provided euro liquidity to Hungary and Poland. These arrangements facilitated the implementation of foreign exchange easing measures in emerging economies, as the liquidity receiving central banks distribute the foreign exchange to local counterparties in need. In addition, exchange rate policy was also altered in some economies. For example, the PBC abruptly halted the policy of allowing the Yuan to appreciate gradually against the US dollar. In 2008, the Monetary Authority of Singapore (MAS) shifted to a 0 per cent appreciation of the nominal exchange rate in a reversal of a policy of gradual appreciation that had followed by the MAS since April 2004.

***Credit and Quantitative Easing Measures*:** The use of direct QE or credit easing in emerging economy central banks has been minimal. The RBI initiated a programme for the actual/potential provision of primary liquidity amounting to Rs. 5.6 trillion (10.5 per cent of GDP).

Part III: Significance and Impact of Unconventional Monetary Policies

The impact of UMP measures, particularly QE can be analysed on the basis of two main approaches. First, based on the historical experience and second, based on the contemporary practice of major central banks, predominantly in advanced countries. However, the evidence on the effectiveness of UMP measures remains mixed and is subject to controversy.

8. Historical Experiences

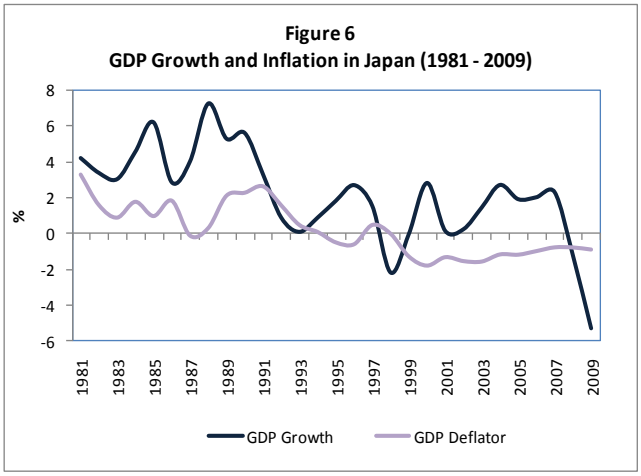
a. The Quantitative Easing Programme in 1930s and 1940s

The experience of the 1930s indicates that QE would work, although there is a risk that it could allow inflation to increase above the desired levels. In April 1932, the Fed started large scale open market purchases and as a result, corporate bond yields started falling decisively within a month. As industrial production recovered, the stock market rebounded, though it fell back in early 1933. The Fed continued with QE through 1934 and eventually the recovery process began. Meanwhile, Japan turned severe deflation into near double-digit inflation in 1932, which continued to increase for the next decade. The Fed similarly printed money to buy bonds after World War II, converting the mild deflation of 1949 into 10 per cent inflation during the following period.

b. Japan's Quantitative Easing Programme in 2000s

On March 19, 2001, the BOJ adopted a new monetary easing framework of the QE in response to the economic downturn triggered by the burst of the global IT bubble. This QE programme consisted of three pillars; (i) the BOJ changed its main operating target for money market operations from the uncollateralized overnight call rate to the outstanding balance of the current account balances (CABs) held by financial institutions at the BOJ, (ii) the BOJ committed itself to maintain the above procedure until the core inflation (headline excluding perishables) became stably zero or above, and (iii) the BOJ would increase the amount at the outright purchase of long-term Japanese government bonds (JGBs), up to a ceiling of the outstanding balance of banknotes issued, if it is necessary to ensure the smooth provision of liquidity (Shiratsuka, 2009).

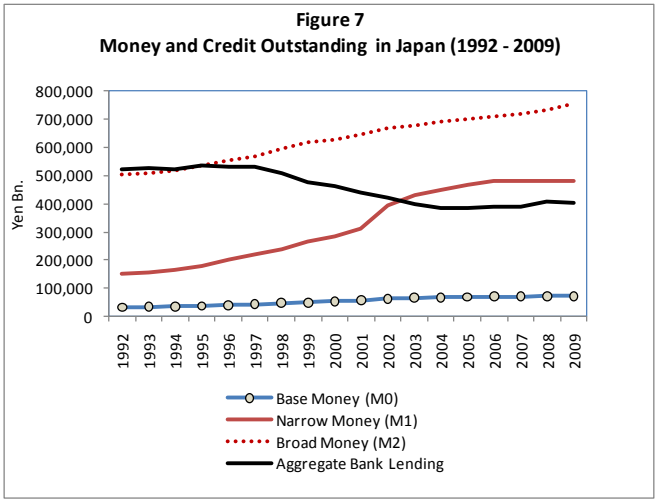
The QE programme started with a CAB target at 5 trillion yen, and the target was then gradually increased in response to the decline in economic activity. It was finally raised to 30-35 trillion yen in January 2004, and remained unchanged at that level until the QE was terminated in March 2006. Reflecting the ample liquidity provision under QE, the uncollateralized overnight call rate fell to 0.001 per cent. To meet the CAB target smoothly, the BOJ gradually increased the outright purchase of long-term JGBs from the initial pace of 400 billion yen per month, setting the amount at 1,200 billion yen per month beginning in October 2002. From July 2003 to March 2006, as a temporary measure, the BOJ purchased ABSs with a view to support the development of the ABS market and to strengthen the transmission mechanism of monetary policy. Consequently, core inflation turned positive in November 2005. On March 9, 2006, the BOJ decided to terminate the QE programme and to return the operating target of money market operations to the uncollateralized overnight call rate, while maintaining the rate at effectively zero per cent (Shiratsuka, 2009).

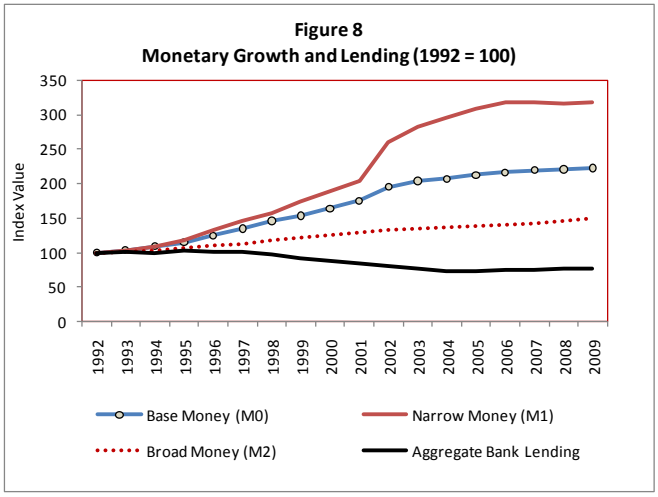


Source: International Financial Statistics (IFS)

The effects of the BOJ's QE policy is largely explained focusing on financial markets, since empirical evidence suggests that the expansion in monetary base had limited effects on aggregate variables, such as output and inflation. Given the fragile conditions in financial markets, the ample provision of reserves, coupled with the policy commitment of maintaining zero interest rates for a considerable period, resulted in a strong liquidity effect. The changes in the shape of yield curves (policy duration effect) was effective in stabilizing market expectations regarding the future path of short-term interest rates, thereby bringing longer-term interest rates down to flatten the yield curve. Also term spreads (the difference between the term contracts of Japanese Yen Tokyo interbank offered rates and the overnight call rate) declined significantly. Hence, the QE played a certain role in Japanese economy, in particular by way of stabilizing the financial system. Such effects failed to transmit to the outside of the financial system suggesting that the transmission channel between the financial and non-financial sectors had been blocked (Shiratsuka, 2009). The policy duration effect failed to reverse deflationary expectations in financial markets on a permanent basis indicating that monetary policy alone could not reverse deflation, coupled with low economic growth (Okina and Shiratsuka, 2004). Hence, despite undertaking a massive QE programme, the Japanese economy did not recover as expected and deflation remained a prolonged issue. The scenario suggests that 'printing money' does not necessarily result in runaway inflation (Luu and Pexton, 2009).

At the same time, the QE programme produced certain side-effects by pushing short-term interest rates down to virtually zero, which was evident through the deterioration in the money markets. Market participants lost the incentive to engage in transactions in the call market and lenders could not cover transaction costs, given tight interest margins as the overnight call rate remained very close to zero. Borrowers did not need to raise funds in the money market primarily because the funds-supplying operations of the BOJ offered the primary means of financing. During the episode of QE between 2001 and 2006, excess reserves held by banks at the BOJ rose from 5 trillion yen to 35 trillion yen (Luu and Pexton, 2009). That implies that the money markets under zero interest rates with ample liquidity almost stopped functioning as a risk-sharing device among financial institutions (Shiratsuka, 2009). Hence, simple increase in base money did not cause in substantial increase in broad money in Japan. Also, it does highlight that QE is not inflationary, if recovery fails to take place (Oliver, 2009).





Sources: Thomson Reuters Datastream and IFS

Several reasons, however, contributed to this outcome: first, policymakers hesitated before reacting to the threat of deflation. Precisely, Japan's QE programme was only implemented in 2001, more than ten years after the onset of the crisis. Second, Japan announced that it would inject public funds into undercapitalized banks only in late 1997. Third, global productive capacity expanded strongly during the 1990s, driven by economic liberalization in China, India and other emerging markets. The integration of Chinese factories and Indian call-centres into the supply chains of multinational companies was a major disinflationary force for much of the decade (Luu and Pexton, 2009).

9. Unconventional Monetary Policies During 2007 - 2010

The impact and the effectiveness of recent UMP measures are subject to intense debate. For example, it is mentioned that the recovery in the global economy earlier than expected is due to the measures taken both by governments and central banks (IMF, 2010b). In some cases, not 'all' measures taken before, during, and after the crisis are considered as effective. For example, extraordinary measures taken in the period ahead the panic are considered as ineffective, and some were harmful (Taylor, 2010). Particularly, in the case of US, the TAF did not reduce tension in the interbank markets as it drew attention away from counterparty risks in the banking system. Also, the bailout measures (first with Bear Stearns) were considered as most harmful as it led people to believe that Fed's balance sheet would be available in the case of another similar institution, such as Lehman. The Troubled Asset Relief Program (TARP) coincided with the severe panic in the following weeks. Hence, the Fed's ad hoc bailout measures were considered as an integral part of a generally unpredictable and confusing government response to the crisis and led to panic (Taylor, 2010).

However, in general, actions taken during the crisis to support commercial paper market and money market funds are considered as helpful (Taylor, 2010). Some argue that while the QE in the strict sense is likely be ineffective at all times, the targeted asset purchases by a central bank can be effective when

financial markets are sufficiently disrupted. Neither is considered as a perfect substitute for conventional interest-rate policy, but purchase of illiquid assets particularly is likely to improve welfare when the zero lower bound on the policy rate is reached (Curdia and Woodford, 2010).

The impact and the effectiveness of UMP measures including QE in recent times can be described under two areas: (i) the impact on financial markets mainly on asset prices such as equity prices and exchange rates, and (ii) the impact on macroeconomic outcomes, particularly on growth, money and credit aggregates and inflation[9].

Impact on Prices of Financial Instruments: When the Fed announced that it would commence buying mortgage related debt and subsequently increased purchases along with buying government bonds, mortgage rates since then dropped. Also, in March, 2009, the yields dropped considerably on the announcement of the purchase programme of treasury securities by the Fed. For example, the yields of the 7 and 10-year dropped 53 and 51 basis points respectively, while the 3 and 30-year yields decreased with 31 and 26 basis points, respectively. The Fed's Large Scale Asset Purchases (LSAP) of agency debt, MBS and long-term US Treasuries reduced long-term US bond yields and long-term foreign bond yields and also the spot value of the dollar.

The interest rate cuts by the ECB have led to a corresponding decline in nominal and real yields in the Euro area. As expectations regarding Euro area inflation remained well anchored in line with price stability, real rates at such maturities fell substantially. Providing central bank liquidity to banks in unlimited quantum at a fixed rate exerted significant downward pressure on money market rates and downward pressure on bank lending rates. Consequently, interest rates on short-term loans declined steadily and overall financial market volatility decreased accordingly. At the same time, the purchase of covered bonds by the ECB has contributed to the revitalisation of the covered bond market and to the decline of covered bond spreads.

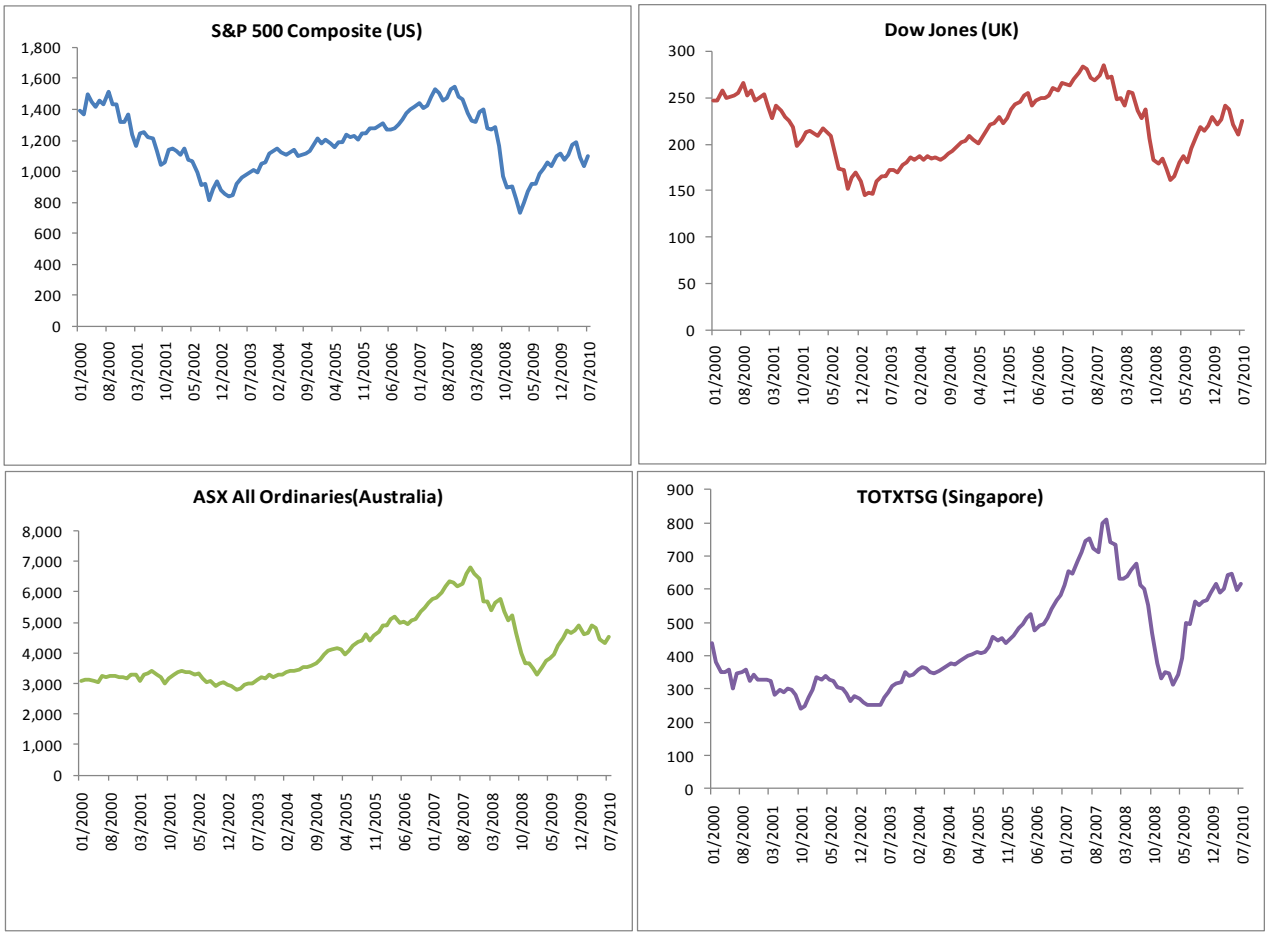
Asset prices in the UK also recovered substantially. Corporate bond yields fell significantly following QE announcements. There were improvements in liquidity in corporate bond markets, and substantial increases in net equity and corporate bond issuances (Joyce, Lasaosa, Stevens and Tong, 2010).

Although equity prices in many countries fell immediately after the initial QE announcements, they have recovered significantly thereafter.

[9] However, it should be noted that although there is a substantial impact of UMP on the recovery, all of the improvements cannot be attributed entirely to UMP.

Figure 9

Movements in Equity Indices in Selected Countries



Source: Thomson Reuters Datastream

Figure 10

Benchmark 5-Year Govt. Bond Index

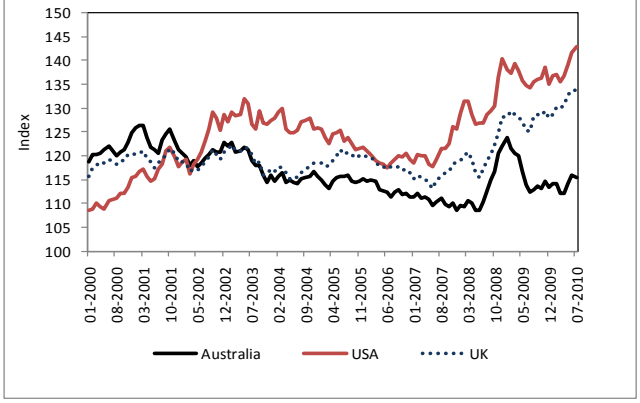
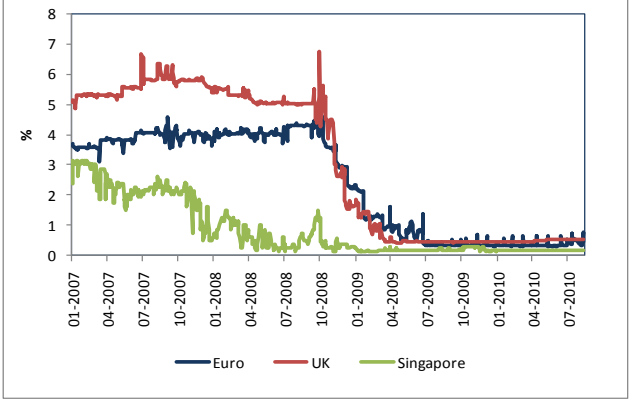


Figure 11

Inter-bank Interest Rates

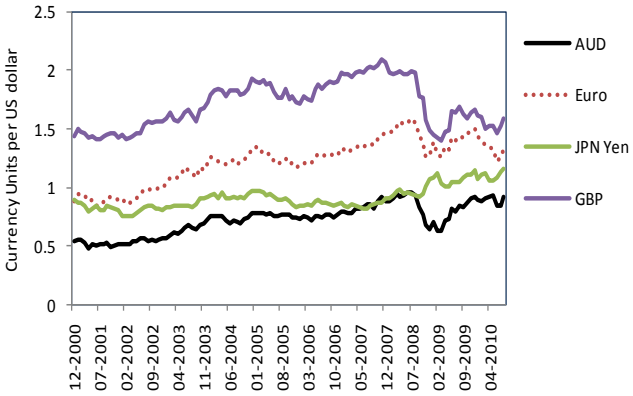


Source: Thomson Reuters Datastream

Impact on Exchange Rates: The creation of new money increases the supply of a currency in circulation meaning that the nominal value of every unit of the respective currency will decrease. Such experience was visible when the BOJ formally announced its QE policy in March 2001. As the BOJ lowered interest rates to almost zero and it bought assets in order to lower credit spreads, there was

a significant expansion in the monetary base (currency in circulation) and depreciation in the Japanese Yen, which fell by more than 20 per cent against the Sterling, Euro and Australian dollar between 2001 and 2007.

Figure 12
Currency Movements against US dollar



Source: Thomson Reuters Datastream

With the increase in the supply of US dollars, there would have been a tendency to a decline in the value of the US dollar. In fact, it fell sharply for some time. However, such trend did not continue. The US dollar was mainly benefited from the serious debt problems in Eastern Europe and also the worsened conditions in the European economy and their bank's conditions inducing QE in aggressive moves.

Impact on Monetary Growth: UMP measures have resulted in substantial changes in the size and the composition of balance sheets of central banks with varying implications for the monetary base. During the recent period, balance sheets have exploded mainly due to three unprecedented initiatives of central banks: providing liquidity, credit easing (or qualitative easing), and QE (asset purchases) facilities (Kozicki, Santor and Suchanek, 2010). Such change in the monetary base is considered as a summary indicator of the impact of UMP (Minegishi and Cournède, 2010). Particularly, the monetary base is more informative as an indicator when considering not only the size of its changes but also the composition of the counterparty transactions.

The implementation of UMP measures has had different impacts on balance sheets across key central banks. Particularly, significant alterations have been observed for the Fed, the BOE and the SNB, with the monetary base increasing by 100 per cent or more. With the liquidity easing, credit easing and asset purchase facilities, the balance sheet of the US Fed has more than tripled from US dollars 870 billion before the crisis to roughly US dollars 2.3 trillion by January 2010. In the case of Fed, several observations can be noted. First, the initial implementation of liquidity measures did not radically affect the balance sheet. On the asset side, the Fed's holding of Treasuries fell, replaced by

the assets that were exchanged as a part of the TAF and for swap lines. After the collapse of Lehman, the balance sheet expanded rapidly as liquidity easing measures were expanded, and as the Fed bailed out AIG. Further balance sheet expansion occurred as the Fed introduced credit easing measures, such as the Commercial Paper Funding Facility (CPFF). The announcement and implementation of the decision to buy MBSs and Government Sponsored Enterprise (GSE) debt, Treasuries, and then assets under the TALF, led to another round of expansion of the balance sheet. At the same time, the liability side of the balance sheet began to evolve. On the liability side, bank excess reserves expanded rapidly, encouraged by the paying of interest on such reserves (IMF, 2010a). In this context, not only the size, but also the composition of the Fed's balance sheet has been altered. Before the sub-prime crisis, the Fed's balance sheet was simple and hence, it consisted mainly of US Treasuries on the asset side and currency in circulation plus a small amount of reserve balances on the liability side. The Fed's decision to buy private sector securities such as commercial paper, longer-term securities as well as agency mortgage securities led such expansion in the balance sheet.

Figure 13
Factors Affecting Reserve Balances

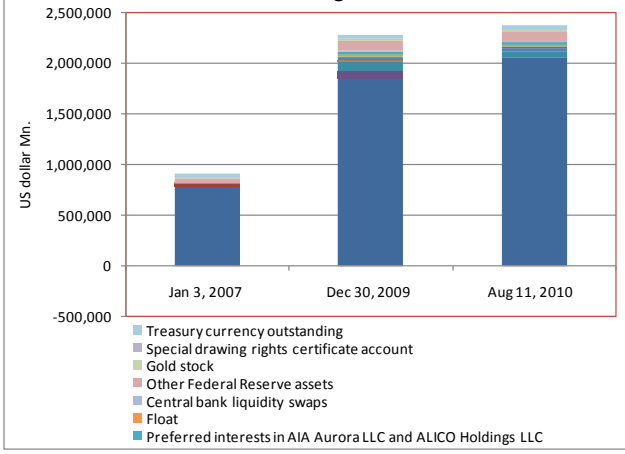
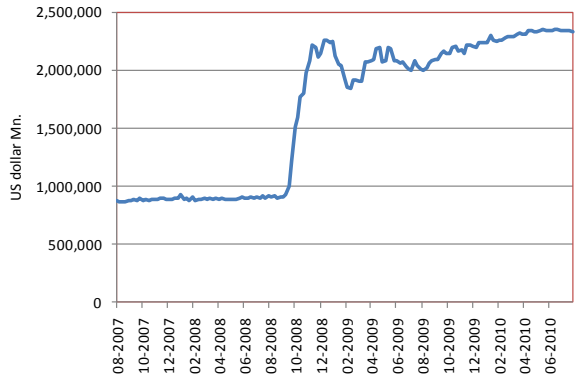


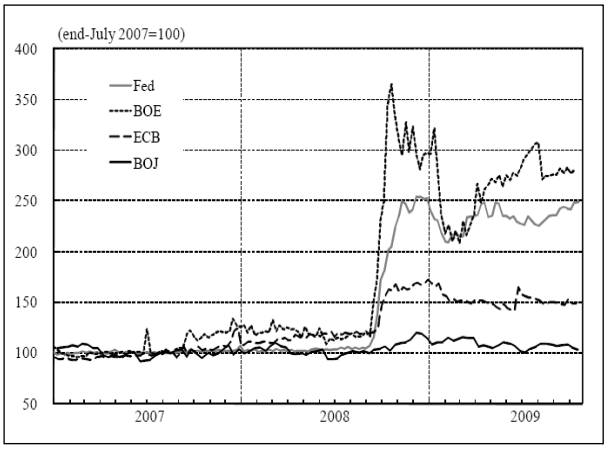
Figure 14
Total Assets of Federal Reserve System



Source: US Fed, H 4.1 Release

While the implementation of UMP measures by the Fed led to dramatic changes in its balance sheets, other central banks have also experienced similar alterations in their financial positions. For example, the BOE balance sheet also tripled to nearly Sterling pound 300 billion. At the same time, the ECB's balance sheet increased by 60 per cent to temporarily Euro 2.1 trillion.

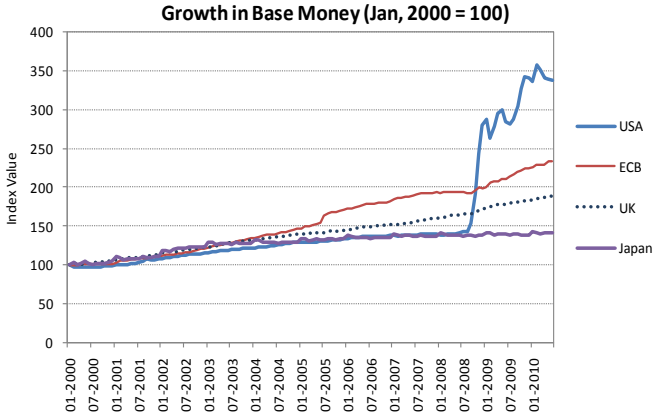
Figure 15
Total Assets for Major Central Banks



Source: Extracted from Shiratsuka (2009)

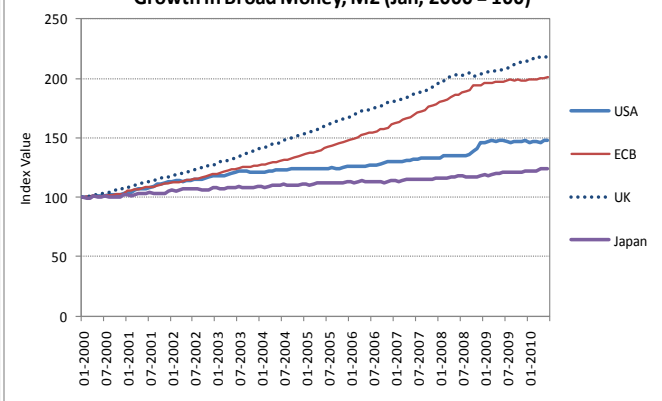
As a result of the balance sheet expansions, the new money injected into systems has increased significantly.

Figure 16
Growth in Base Money (Jan, 2000 = 100)



Source: Thomson Reuters Datastream

Figure 17
Growth in Broad Money, M2 (Jan, 2000 = 100)

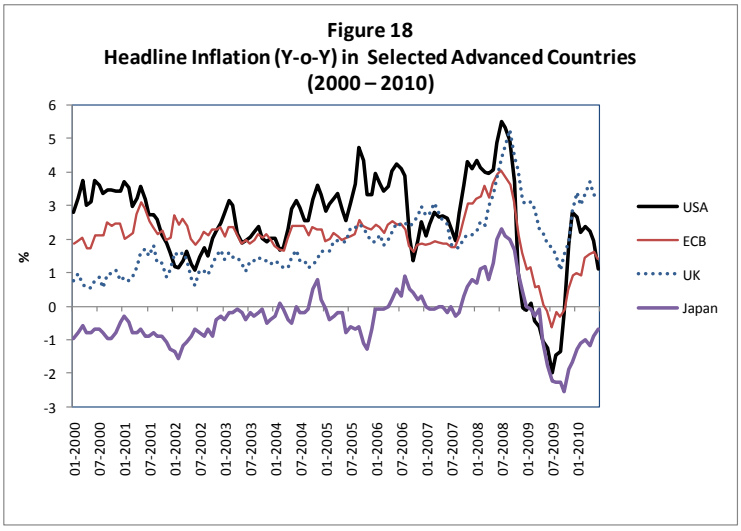


Source: Thomson Reuters Datastream

Impact on Price Levels: Adopting UMP measures in significant magnitudes may put economies into an unstable situation particularly when central banks are not in a position to remove excess liquidity from the system once the economy is stabilized. Although the balance sheet expansion needs to be a temporary policy response, the permanent portion of the expansion does matter with regard to the effects on general prices in the medium to longer-term. Hence, when the increase in bank reserves and cash lead to broader increase in credit and economic activity, it will generate inflation risks. Also, there is a risk that central banks cannot drain liquidity from the system in a timely and effective manner to prevent further build in inflationary pressures. Hence, to avoid the adverse effects on general prices, any expansion of the balance sheet needs to be confined to sustainable levels in the

medium to long term, even though an extraordinary expansion is allowed temporarily to absorb the shocks hitting the economy (Shiratsuka, 2009).

If a central bank is cautious of controlling inflation, then it has to be careful about its balance sheet. If a central bank has to expand its balance sheet beyond normal conventions, it will have to tolerate some inflation (Cecchetti, 2003). Based on this premsie, some argue that inflation spirals would be out of control particularly in the US aftermath the current crisis (Sims, 2008). Also, when it is politically difficult to reduce the size of the balance sheet as the economy recovers and as public debt increases, then there is a risk of inflation (Taylor, 2010). History has shown that central banks become less independent of governmental policy in times of financial crisis and hence, the independence of central banks arresting inflation could be under stress[10]. On the other hand, public perceptions of UMP may also fuel inflation expectations. Particularly, public might have concerns that expanding the central bank balance sheet will result in monetizing government deficits.



Source: Thomson Reuters Datastream

Part IV: Empirical Evidence on the Impact of Unconventional Monetary Policies

10. Literature Review

The theoretical literature on UMP has developed extensively over the past 20 years, however, the empirical evidence of the impact and effectiveness of UMP has been much more limited. Typically, many difficulties occur when estimating the impact of these policies directly from the data. Also, for, at least

[10] Although central banks in advanced economies are mostly independent from elected governments, this was not always the case. Sargent (1983) identified fiscal policy, particularly persistent budgetary deficits, as one of the root causes of the explosion in price levels in Germany, Austria, Hungary and Poland in the years between World Wars I and II. The most notable of these was the hyperinflation in Germany in the early 1920s and in Zimbabwe in 2000s.

until recently, the lower bound episodes were almost exceptional, limiting the direct econometric inference (Garcia-Cicco, 2010). The available limited studies focus on various aspects of the impact of UMP such as on yields, prices, output and currencies, etc. At the same time, mixed results can be observed, particularly in terms of the impact on output, prices and transmission mechanism. This section outlines key empirical research findings in this regard.

Kuttner and Posen (2001) used a vector auto regression (VAR) model to investigate the impact of the monetary base expansion due to QE on broad money and prices, for Japan and find no significant impact since 1990. They do not find evidence that QE policies tend to weaken the Yen either. In order to examine the response of prices to trend M0 growth, they regress the logarithm of the price level on the monetary base and real GDP to forecast the price level through 2001:1. Since M0 and prices do not indicate cointegrated relationship, and since deflation has occurred despite robust M0 growth, the model equation over predicts the price level since 1990. To assess the impact of transitory movements in the monetary base, Kuttner and Posen also use a VAR model with the same other variables used with M2, but modify it to treat M0 as trend stationary and to leave out the error correction term. Consistent with its trend-stationary characterization, the impact of monetary shock on the base itself appears to die-out over time. The shock initially increases prices, but the effect reverses after a few quarters. They conclude that given the weak link between M0 and M2 (and thus, between M0 and prices), an increase in high-powered money has only a limited effect if banks are unable or unwilling to lend additional reserves.

Taking into account the regime change in monetary policy and the possible non-linearity of money demand at low (or near zero) interest rate, Kimura, Kobayashi, Muranaga and Ugai (2002) estimate a Bayesian VAR (a VAR with time varying coefficients) to extract the effect of the increase in monetary base at zero interest rates. The results indicate that while an increase in monetary base previously had a positive impact on prices; it does not at zero interest rates. In order to investigate the possible reason for this, they then estimate a money demand function, and test whether a satiation level in demand for monetary base exists at zero interest rates. The key finding is that the null hypothesis of the non-existence of the satiation level can be statistically rejected meaning the possibility for any increase in monetary base to stimulate the economy at zero interest levels.

Bernanke et al (2004) assess the potential effectiveness of UMP and analyse the behaviour of selected asset prices over short periods surrounding central bank statements or other types of financial or economic news and estimate 'no arbitrage' models of the term structure for the US and Japan. As such, using a VAR in five variables (a measure of the employment gap, inflation over the past year, expected inflation over the subsequent year, the Fed funds rate and the year-ahead Eurodollar futures rate), they develop new empirical evidence on the likely effects of non-standard monetary policies near the zero bound. They find some evidence that relative supplies of securities matter for yields in the US, which is a necessary condition for achieving the desired effects from targeted asset purchases. The event studies for Japan do not provide much evidence that the BOJ has been successful in using non-standard policies, but

the term structure analysis do suggest that longer-term yields have been lower than otherwise would have been expected. Regarding impacts on output and inflation, Bernanke et al. run simulations of QE policies on simple macro models for the US and Japan. They find that increases in CAB levels did have positive impacts on output and prices in both countries, although the impacts for Japan were much less than those for the US.

Based on the Japanese experience, Okina and Shiratsuka (2004) indicate that QE was not perceived as a sufficient stimulus to curb deflation, coupled with low economic growth. This suggests that there was slight independent contribution from QE beyond that of the commitment effect[11], which did seem to flatten the yield curve.

There is some evidence that the ample provision of liquidity did ease funding constraints of banks and shrink credit spreads. Baba, Nakashima, Shigemi and Ueda (2005) find a positive effect of increasing CAB levels on reducing the dispersion of bank credit spreads in the interbank market. They notice that as the BOJ had to fund successively higher CAB levels, it had to move further out along the yield curve to conduct its operations, which tended to flatten the yield curve. They conclude that both the commitment effect and QE probably tend to reduce credit spreads in the interbank market, although their relative contributions are not quantified.

Estimating a VAR model, which include five variables — the CPI, industrial production, foreign exchange rate, 10-year JGB yield, and a monetary policy proxy, Kamada and Sugo (2006) identify changes in policy stance and to capture policy effects without limiting transmission channels. Using impulse responses of prices and production against monetary easing, their model show that policy effects decline with the inclusion of the QE period at the end of the data sample. While estimating the point of structural change generated in the monetary policy transmission channel, they find structural change around the end of 1990, which corresponds to the peak of the asset price bubble, but identify no subsequent structural changes. They conclude that, in addition to the zero bound constraint on interest rates and the erosion of banks' financial intermediary functions, the worsening of corporate balance sheet problems and the breakdown of the mechanism that amplifies economic activity limited the effects of monetary easing.

In order to measure the effect of the QE on aggregate output and prices, and its transmission mechanism, Honda, Kuroki and Tachibana (2007) estimate a VAR model and suggest that further injection of base money is effective even when short-term nominal interest rates are at zero bound. They find positive impacts on output but not on prices in the context of Japan. They also identify equity prices as the main channel by which the QE policy affected output implying that the portfolio-balance effect is the main transmission mechanism.

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[11] Commitment effect: verbal commitments to maintain very low interest rates for a certain period, either conditionally or unconditionally (Morgan, 2009).

In the context of the recent crisis, Bates and Vaugirard (2009) estimate the time-varying VAR (TV-VAR) and conclude at an intermediate position between those who claim the ineffective US monetary policy during the crisis and those who claim an insufficient effectiveness. Dealing with main financial sectors where the source of the crisis is found, they conclude that monetary transmission channels are clearly ineffective.

Gertler and Karadi (2009) develop a quantitative monetary dynamic stochastic general equilibrium (DSGE) model that allows for financial intermediaries that face endogenous balance sheet constraints, and use the model to simulate a crisis that has some basic features of the recent economic downturn. They then use the model to quantitatively assess the effect of direct central bank intermediation of private lending and show numerically how central bank credit policy might help moderate the simulated crisis.

Utilizing a simple DSGE model (incorporating the budgetary independence of the central banks), Park (2009) shows the effect of quasi-fiscal shocks on inflation. In the active quasi-fiscal policy regime, the shocks in the central bank's earnings alter the private agent's portfolio between consumption and the nominal money balance, thus affecting inflation. Hence, Park proves that quasi-fiscal shocks may produce undesirable effects, such as inflation following deflationary monetary policy during the implementation of exit strategy.

Yehoue (2009) studies about 31 emerging market economies that pursued systemic liquidity easing (SLE) measures and finds that economy size, Credit Default Swaps (CDS) spreads, currency depreciation, CABs, and access to international credit markets are among the key factors influencing the adoption of SLE measures. The study also offers a preliminary qualitative assessment of the effectiveness of SLE measures and suggests that the measures have helped to ease the global credit crisis. Moreover, Yehoue show that despite the positive impact of the measures on financial markets, they have not prevented the financial crisis from affecting the real economy.

Estimating a Bayesian TV-Structural VAR, Baumeister and Benati (2010) find that in all the countries they analyse (US, Euro area, Japan, and UK), a compression in the long-term yield spread exerts a powerful effect on both output growth and inflation. Also, conditional on available estimates of the impact of the Fed's and the BOE's asset purchase programmes on long-term government bond yield spreads, their counterfactual simulations indicate that UMP of US and UK have averted significant risks both of deflation and of output collapses comparable to those that took place during the Great Depression.

Curdia and Woodford (2010) extend a basic New Keynesian model of the monetary transmission mechanism to explicitly include the central bank balance sheet as part of the model. They distinguish between QE in the strict sense and targeted asset purchases by a central bank, and argue that while the former is likely be ineffective at all times, the latter dimension of policy can be effective when financial markets are sufficiently disrupted although neither is a perfect substitute for conventional interest-rate policy. They also consider optimal policy with regard to the payment of interest on reserves, and argue

that the interest rate on reserves should be kept near the central bank's target for the policy rate at all times. They find that explicitly modelling the role of the central-bank balance sheet in equilibrium determination need not imply any role for QE as an additional tool of stabilization policy, even when the zero lower bound on the policy rate is reached. Instead there may be a role for central-bank credit policy (or for targeted asset purchases), when private financial markets are sufficiently impaired. Their analysis shows that decisions about interest-rate policy are not constrained in any direct way by decisions about either the size or composition of the central bank's balance sheet, as long as the central bank is willing to adjust the interest rate paid on reserves appropriately.

Extending a New Keynesian model of a small-open economy, Garcia-Cicco (2010) evaluates the effects of several UMP measures and calibrates model for Chile and finds that policies affecting the liquidity channel can potentially have a significant effect, but they depend on expectations about the future policy rate. On the other hand, alternatives working through the term premium have smaller effects, but they are less dependent on the expected path of the reference rate. The results indicate that policies working through the liquidity channel can potentially have important expansionary effects, which are generated not by the direct effect that a monetary expansion have in reducing the rate faced by households, but rather through the expected future inflation that the increase in base money generates.

Michele, Pill and Reichlin (2010) estimate a Bayesian VAR for the Euro area, which includes real, nominal, and disaggregated credit and monetary variables with the associated interest rates. Their estimates indicate that the effect of the compression of the spreads has been sizeable on loans and interest rates, very modest on broad money, and has acted on the real economy with a delay. These effects are very much in line with what has been found for the transmission of a standard monetary policy shock in normal times. Overall, their results suggest that UMP measures played a quantitatively significant role in stabilizing the financial sector and economy after the collapse of Lehman even though it was insufficient to avoid a significant fall in economic and financial activity.

11. Empirical Investigations

a. Data and Data Properties

Following Kuttner and Posen (2001) and Kimura et al (2002), a baseline monetary model is estimated based on the multivariate modelling techniques using monthly data over a sample of 2000:01 – 2010:06 for four major countries, namely US, the UK, Euro area (EU) and Japan.

The specific models considered here contain four variables: price levels (measured by headline consumer price index), output (measured by industrial production index), monetary aggregates (represented by base money and broad money) and the central bank policy interest rate (represented by

overnight interbank interest rate)[12]. Although such benchmark model provides a simplistic description of the economy, it contains at least a minimum set of variables that are crucial for any decision of monetary policy (Kimura et al, 2002) and is also consistent with monetary theory.

Table 10

Variable Used for Modelling Exercise*

Country	Variable	Code
US	Industrial Production Index	usipi
	Consumer Price Index (All Urban Consumers)	uscpi
	Base Money (M0)	usm0
	Broad Money (M2)	usm1
	Fed Funds Rate	usoninterestrate
UK	Industrial Production Index	ukipi
	Consumer Price Index	ukcpi
	Base Money (M0)	ukm0
	Broad Money (M4)	ukm4
	Sterling Overnight Interest Rate	ukoninterestrate
EU	Industrial Production Index	euipi
	Consumer Price Index	eucpi
	Base Money (M1)	eum1
	Broad Money (M2)	eum2
	Overnight Money Market Rate	euoninterestrate
Japan	Industrial Production Index	jpipi
	Consumer Price Index	jpcpi
	Base Money (M0)	jpm0
	Broad Money (M2)	jpm2
	Uncollateralized Call Money Rate	jponinterestrate

Note: M4 is considered as the most appropriate series for UK and base money in EU is referred as M1.

*All variables are seasonally adjusted using US Census Bureau's X-12 seasonal adjustment programme within EViews, except for interest rates.

The specified model serves for two main purposes: first, to predict the possible changes in output and prices due to monetary expansions as a result of UMP measures adopted during the crisis and, second, to identify possible shifts in monetary transmission mechanism in subject countries during the crisis. Hence, innovations money stock, which is represented by base and broad money and innovations in the money market rate, which is the proxy for central bank policy within a multivariate framework, are examined to allow for the interaction of money and interest rates with other macroeconomic variables.

Figure 19 (Panel) depicts the movements of selected variables and it is clearly noted that there are breaks in series particularly during the crisis time.

[12] Data sources and variables with necessary descriptions for each country are given in Annex I.

Figure 19

Output, Prices, Money and Interest Rates in US, UK, EU and Japan (2000 – 2010)

Source: Thomson Reuters Datastream; IFS; Respective Central Banks

To choose the specification of the variables in the model, the time series properties of those variables are examined. First, unit root tests were conducted to check for stationarity of series[13]. The augmented Dickey–Fuller (ADF) tests all fail to reject a unit root in the levels of these time series. Unit roots can be rejected in first differences of all series indicating that all series are non-stationary I (1)[14]. Second,

[13] See Annex II for results of unit root tests.

[14] The power of unit root test is low in the presence of structural breaks as the ADF test finds it difficult to distinguish between a stationary process subject to structural breaks and a unit root process (Brooks, 2008). Hence, unit root tests were conducted for sub-samples as well.

cointegration among the variables was also tested. Both Johansen's λ -max and λ -trace tests decisively reject the hypothesis of no cointegration for variables. Further tests indicate that there are most likely three or four cointegrating vectors in each set indicating long-run relationships[15].

b. Model Specification

The econometric theory admits that VAR model is a general framework that can be used to describe the dynamic interrelationships between stationary variables and hence, if variables in the system are stationary I (0) variables, a VAR at levels can be estimated. However, if the variables in a system are non-stationary (although they are cointegrated), Sims, Stock and Watson (1990) and Lutkepohl and Reimers (1992) indicate that estimation of the VAR in (log) levels will provide consistent estimates[16].

However, if variables are I(1) and cointegrated, then the system is required to allow for cointegrating relationships between the I(1) variables in order to retain and use valuable information on long-run stochastic relations and also to use the most appropriate technique that takes into account the properties of time-series data (Hill, Griffiths and Lim, 2008). Such relationship can be utilized to develop a refined dynamic model, which deploys the focus on long-run or transitory aspect that adds the error correction feature to a multi-factor (VAR) model. Introducing the cointegrating relationship leads constructing a vector error correction (VEC) model (Brooks, 2008; Engle and Granger, 1987; Hill et al, 2008). Hence, a VEC modeling is considered as the most appropriate model for this empirical exercise, which can be illustrated as follows:

If two non-stationary variables y_t and x_t that are integrated of order 1: $y_t \sim I(1)$ and $x_t \sim I(1)$ and proved to be cointegrated, so that:

$$y_t = \beta_0 + \beta_1 x_1 + e_t \qquad (3)$$

The VEC model is a special form of the VAR for I (1) variables that are cointegrated. The model can be specified as:

$$\Delta y_t = \alpha_{10} + \alpha_{11} + (y_{t-1} - \beta_0 - \beta_1 x_{t-1}) + v_t^y \qquad (4)$$

$$\Delta x_t = \alpha_{20} + \alpha_{21} + (y_{t-1} - \beta_0 - \beta_1 x_{t-1}) + v_t^x \qquad (5)$$

and can be expanded as

[15] See Annex III for results of cointegration tests.

[16] This has been followed by most of the VAR proponents when modelling monetary policy innovations in an economy although series are non-stationary and cointegrated(for example: Ramaswamy and Sloek (1998); Holtemoller (2002) and Berument and Froyen (2006).

$$y_t = \alpha_{10} + (\alpha_{11} + 1)\, y_{t-1} - \alpha_{11}\beta_0 - \alpha_{11}\beta_1 x_{t-1}) \quad + v_t^y \qquad (6)$$

$$x_t = \alpha_{20} + (\alpha_{21}\, y_{t-1} - \alpha_{21}\beta_0 - (\alpha_{21}\beta_1 - 1)x_{t-1} \quad + v_t^x \qquad (7)$$

The coefficients α_{11}, $\alpha_{21}$are error correction co-efficient and they show how much Δy_t and Δx_trespond to the cointegrating error $y_{t-1} - \beta_0 - \beta_1 x_{t-1} = e_{t-1}$. The model allows to examine how much dependant variable will change in response to a change in the explanatory variable (the cointegration part, $y_t = \beta_0 + \beta_1 x_1 + e_t$, as well as the speed of the change (the error correction part, $\Delta y_t = \alpha_{10} + \alpha_{11}(e_{t-1}) + v_t^y$ where e_{t-1} is the cointegrating error.

The model used in this study is similar to Hendry and Adam (2002). This estimates a unique and stable long-run cointegrating vector between monthly data for nominal money supply (both base and broad money), real output, the consumer price index, and the short-term interest rate.

The Johansen–Juselius (1990) methodology was used to estimate the long-run cointegrating vector from a VEC of the form:

$$\Delta X_t = \Gamma(L)\Delta X_t + DZ_t + \alpha\beta'[X_{t-1}] \qquad (8)$$

where X_t is a vector of endogenous variables (i.e., money, output, prices, and interest rates), Γ(L)is a matrix of parameters for a fourth-order lag process, Z_t is a vector of stationary exogenous variables, and D is the matrix of parameters associated with the exogenous variables. The α parameters measure the speed at which the variables in the system adjust to restore a long-run equilibrium, and the β vectors are estimates of the long-run cointegrating relationships between the variables in the model.

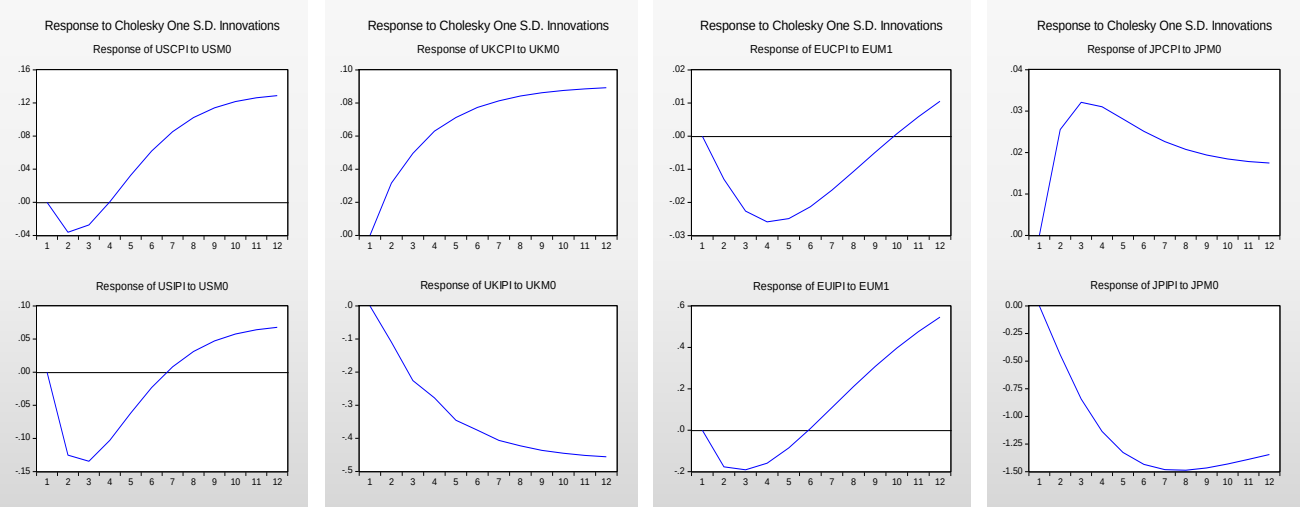
c. Results of Model Estimates

i. Impact on Prices and Output

First, the model was estimated for prices, industrial production, interest rates and base money given the recent expansion in monetary bases due to balance sheet explosion of central banks. As per Figure 20 (Panel), impulse response functions (IRF) indicate that a positive monetary shock cause increases in output and prices after certain lags in the subject countries although with a few exceptions indicating money would drive both output and prices. This also indicates that although there are structural breaks in the sample, the expansion in monetary base is consistent and appropriate to construct a model along with other variables.

Figure 20

Impulse Response Functions of Prices and Output for Base Money Shocks

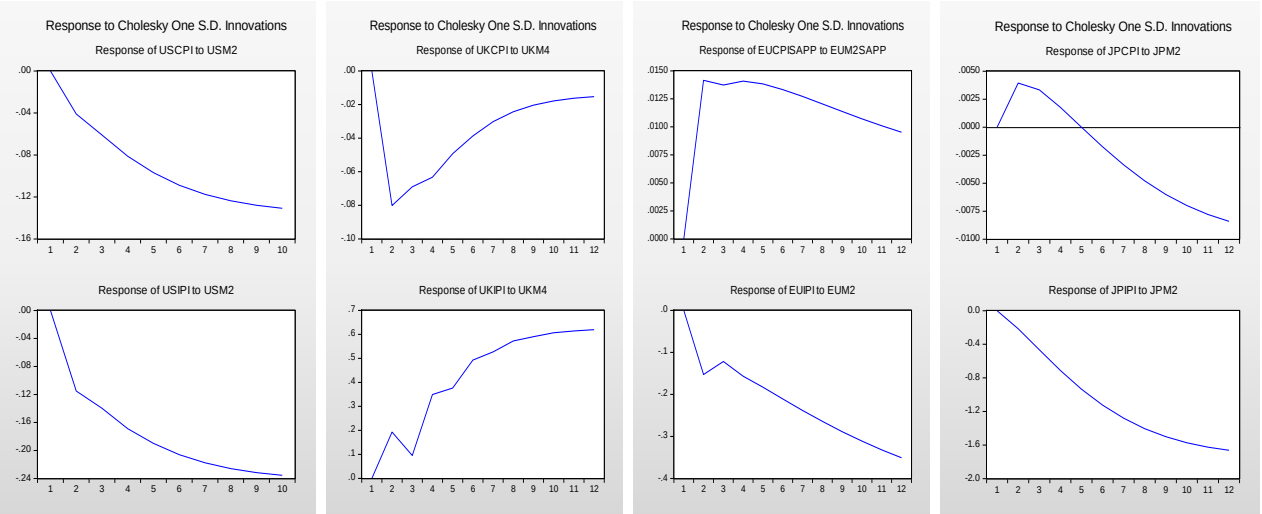


Source: Model Estimates

Then, the same model was estimated using broad money model as price levels in an economy generally and significantly relate with broad money supply since the level and growth in broad money determine the spending ability of the public. Figure 21 (Panel) depicts IRF of prices and output for shocks of broad money and indicates mixed evidence on the relationship between broad money, output and prices. However, this cannot be taken as an impediment for modeling broad money with other variables as there remain structural breaks in the entire sample.

Figure 21

Impulse Response Functions of Prices and Output for Broad Money Shocks



Source: Model Estimates

Next, changes in price levels and output are forecast based on base money and broad money models. As per the model, Table 11 indicate possible pressures on prices during the approaching period, particularly in the US and UK, which is a consistent result with some predictions. Although the level is

appears to be somewhat higher, the direction is broadly consistent with the other predictions such as IMF, World Bank and independent researchers.

Table 11

Comparison of Inflation Forecasts

Group/Country	2009	2010(P)	2011(P)	2012 (p)
IMF				
United States	-0.3	1.4	1.0	na
United Kingdom	2.1	3.1	2.5	na
Euro Area	0.3	1.6	1.5	na
Japan	-1.4	-1.0	-0.3	na
World Bank				
G-7 Countries	-0.2	1.5	1.6	1.8
United States	-0.3	2.0	2.2	2.4
ADB				
G-3 Average	-0.2	1.2	1.3	na
Oxford Economics (Independent)				
United States	-0.3	1.4	1.3	3.1
United Kingdom	2.2	3.1	2.9	1.7
Euro Area	0.3	1.5	1.5	1.6
Japan	-1.4	-0.8	0.1	0.5
Model Forecasts				
United States	-0.3	2.1	3.0	3.2
United Kingdom	2.2	2.0	2.5	2.7
Euro Area	0.3	1.7	1.9	2.2
Japan	-1.4	-1.0	-0.9	-0.1

(P) – Projections

na: not available

Source: ADB 2010; IMF, World Economic Outlook, Oct 2010; World Bank, Global Economic Prospects, June 2010, Oxford Economics, Oct 2010, Model Forecasts

ii. Impact on Transmission Mechanism (Interest Rate Channel)

Generally, transmission mechanism tends to impair during a crisis situation. Based on this premise, in this section, possible shifts in transmission mechanism, mainly the impact of output, prices and money in the presence of interest rate shocks, are examined.

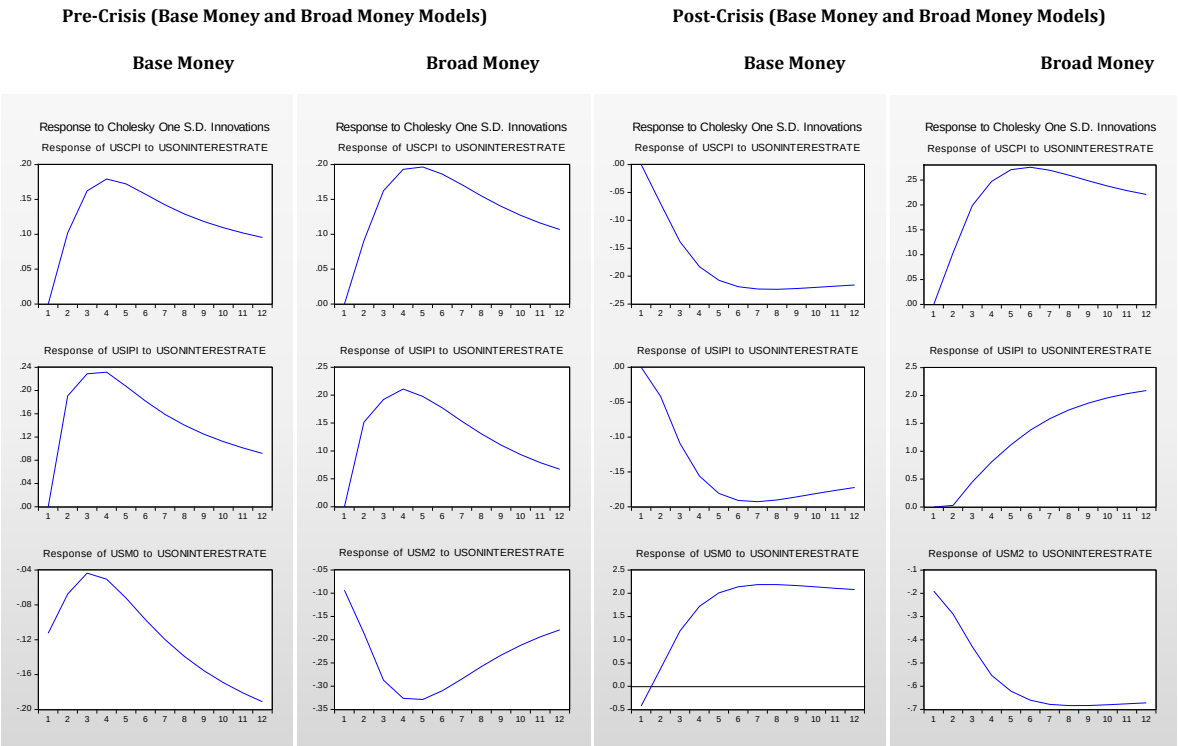
When there is an impact of a crisis within a sample, the full sample modeling strategy, which includes the impact of the crisis will tend to mis-specify the model and hence, policy inferences out of the model are potentially invalid. In such circumstances, sub sample-based modeling strategy is able to account for the effects of the structural breaks and pinpoint the fundamental differences in both the pre-crisis and post-crisis models (Hesse, 2007).

Graphical illustrations of data series indicate that there is a structural break during mid-2007. This is further confirmed by Chow's Breakpoint Test, which indicates that the coefficients are not stable across

regimes[17]. Hence, considering the structural break that occurred by mid-2007, where the sub-prime crisis generated its adverse impacts, the entire sample was partitioned into two sub-samples and compared in order to see any possible shifts in monetary transmission based on the approach used by previous researchers. Accordingly, the full sample was partitioned into two sub-samples: (i) pre-crisis sample (2000:01 – 2007:05), and (ii) post-crisis sample (2007:01 – 2010:06). The post-crisis sample was allowed to overlap with the pre-crisis sample in order to mute undue spikes or downturns in series. A comparison of these two sets of estimates gives a sense of the magnitude of change in the monetary transmission mechanism over time (Sirivedhin, 1998; Taylor, 1995). As sub-samples also confirmed that series are non-stationary and cointegrated, the same VEC models were estimated to test the impact of monetary policy instrument on economic variables[18]. This was the same methodology adopted by Hesse (2007) for Thailand. Figures 24 -27 (Panels) present a comparison between pre-crisis and post-crisis regimes and possible alterations in transmission.

Figure 24

Responses of Output, Prices and Money during Pre-Crisis and Post-Crisis Regimes (US)



Source: Model Estimates

[17] See Annex IV for results of the stability tests.

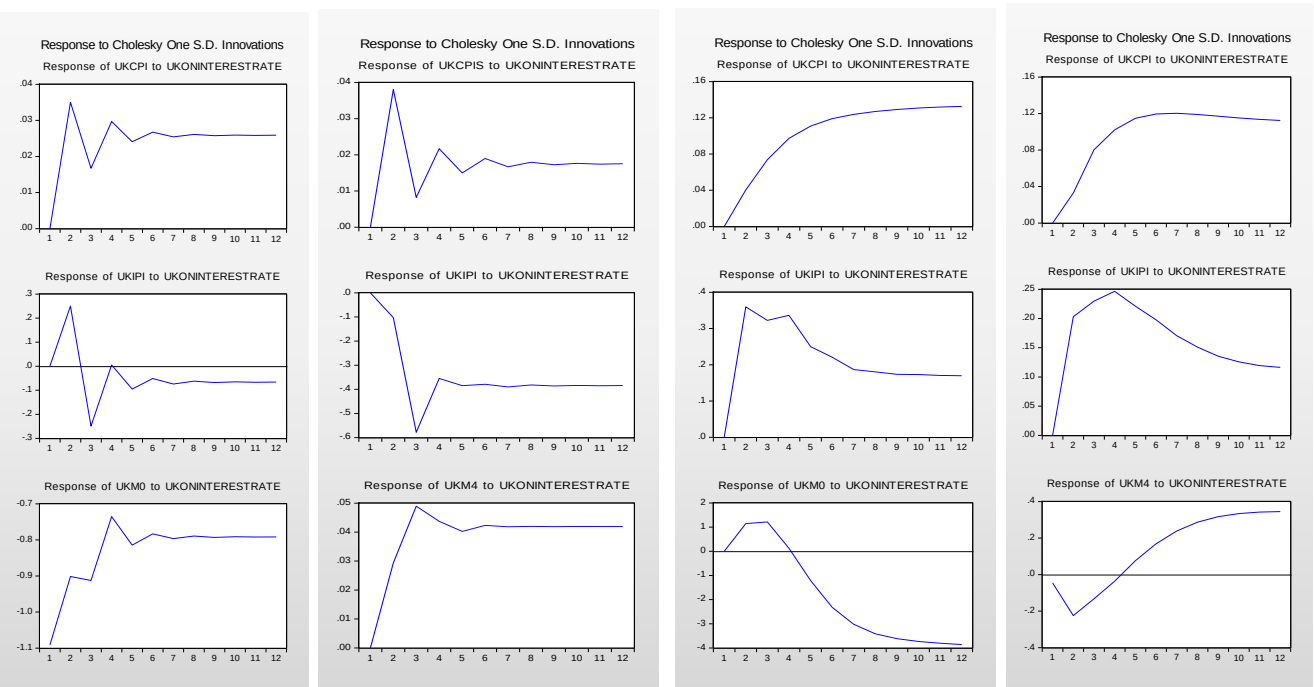
[18] Results of unit root and cointegration tests are not reported for sub-samples due to space limitation, however, available upon request.

Figure 25

Responses of Output, Prices and Money during Pre-Crisis and Post-Crisis Regimes (UK)

Pre-Crisis (Base Money and Broad Money Models) | **Post-Crisis (Base Money and Broad Money Models)**

Base Money | **Broad Money** | **Base Money** | **Broad Money**



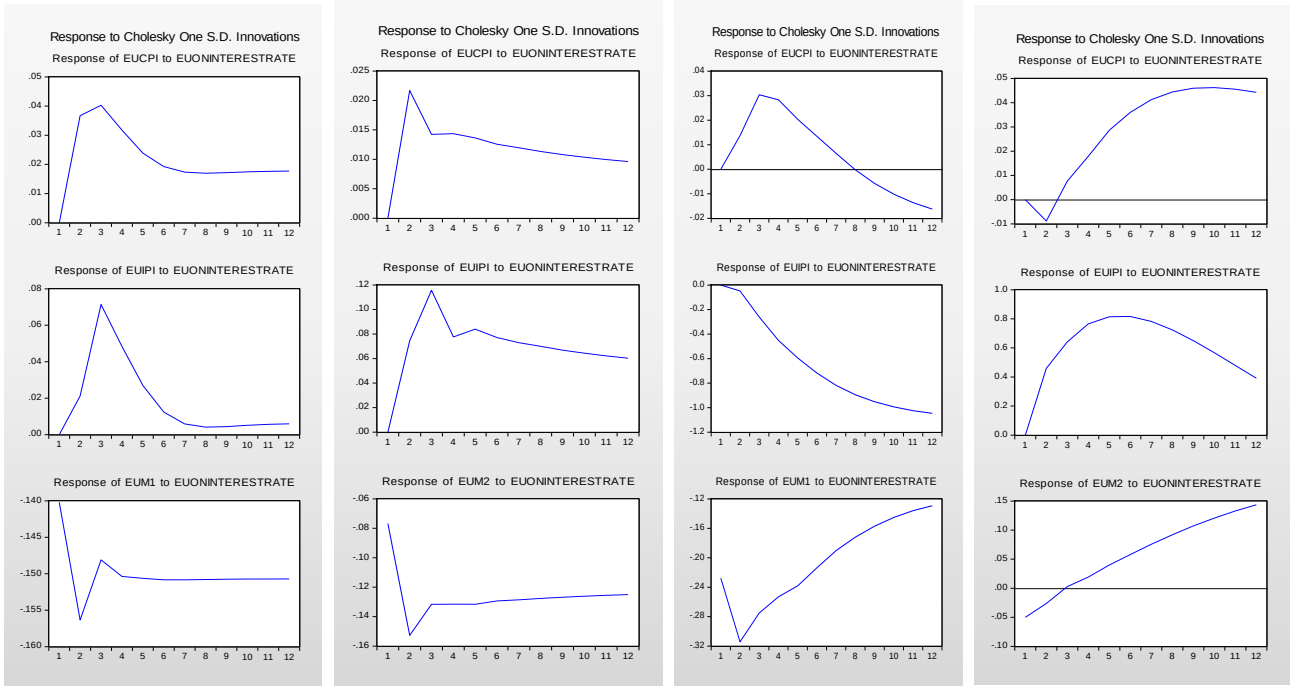
Source: Model Estimates

Figure 26

Responses of Output, Prices and Money during Pre-Crisis and Post-Crisis Regimes (EU)

Pre-Crisis (Base Money and Broad Money Models) | **Post-Crisis (Base Money and Broad Money Models)**

Base Money | **Broad Money** | **Base Money** | **Broad Money**



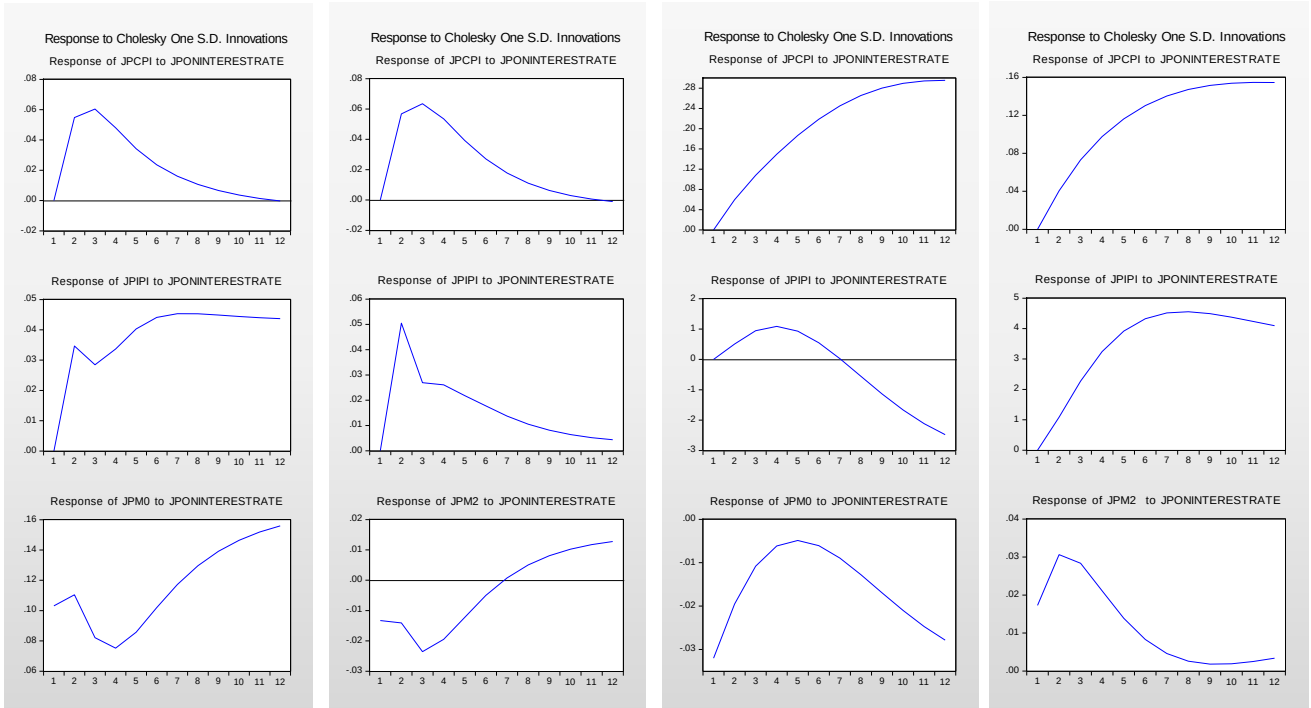
Source: Model Estimates

Figure 27

Responses of Output, Prices and Money during Pre-Crisis and Post-Crisis Regimes (Japan)

Pre-Crisis (Base Money and Broad Money Models) | **Post-Crisis (Base Money and Broad Money Models)**

Base Money | **Broad Money** | **Base Money** | **Broad Money**

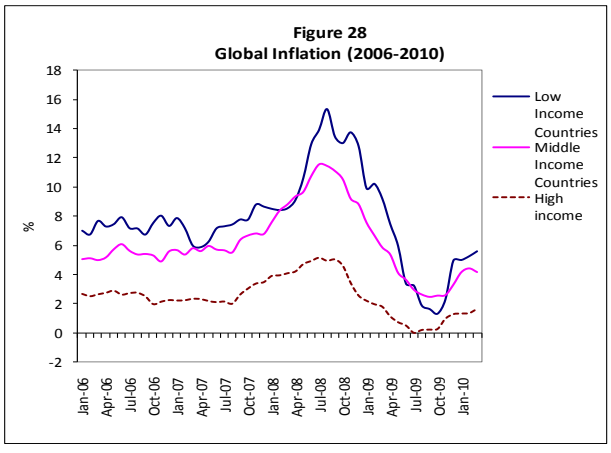


Source: Model Estimates

Results of models for the pre-crisis monetary transmission mechanism are broadly consistent with the common trends and theoretical underpinnings of transmission mechanism. In particular, positive interest rate shocks indicate negative effects on output, prices and money during the pre-crisis period, but such relationship is broken in the most of cases during the post-crisis period, particularly for broad money models indicating possible impairments of the transmission mechanism.

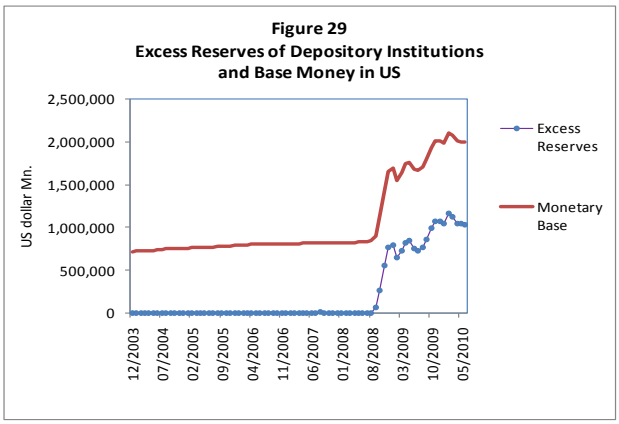
d. Implications of Empirical Results

As proved by IRFs, in many countries, a revival in economic activity would possibly generate demand pressures and hence, upward trends in price levels. Although currently, many advanced countries operate below their potential capacity, revival of economic activity would tend to mounting price pressures. Particularly, benchmark monetary models indicate that output in the US represented by the industrial production index would continue to gather momentum in the approaching period generating positive growth rates (See Annex V for forecasts of the IMF and World Bank). Also, the direction of forecasts for price levels, which is consistent with research findings and observations (for example: Brinkhuis, 2009; Cochrane, 2009; Ellis, 2009; Goodfriend, 2009; Mishkin, 2009; Sims, 2008 and World Bank, 2010) show that price pressures would emerge in the US although some have predicted inflation to remain checked in 2011 despite the temporary upward trend in 2010 (for example: Colgey, 2010; IMF, 2010b and the US Government, 2010). Inflation has already begun to pickup worldwide and many countries have already begun the next cycle of monetary tightening.



Source: World Bank

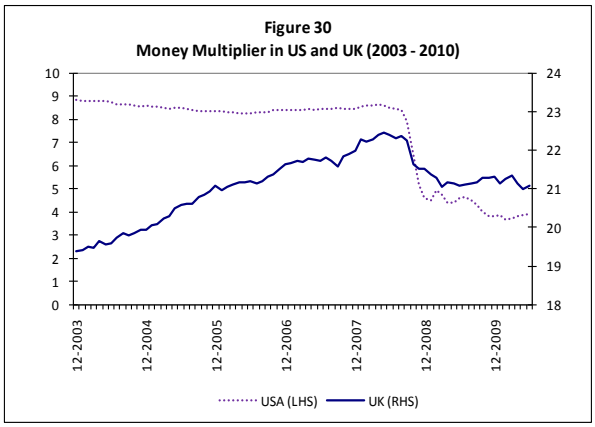
Apart from the lower capacity utilization, from a monetary perspective, the key argument to expect lower inflation is the broken relationship between monetary aggregates. As such, it is argued that there is no immediate threat on inflation, because most of the increase in high-powered money is being held as excess reserves and hence, central banks are not sure whether the new money will be passed on to businesses and households. This was the case particularly in US and also in the UK.



Source: US Fed

In the US, M2 has expanded from 53 per cent to 57 per cent of GDP since September 2007. Although this is a sharp surge, M2/GDP ratio is not substantially higher than it was during 2003. Therefore, while base money has increased dramatically by 145 per cent since end 2007 to end 2009, M2 has grown only by 11 per cent during the same period. For the UK, these figures remain at 172 per cent and 32 per cent respectively, for the same period. This proves that money multiplier has collapsed reflecting a severe breakdown in the ability and the willingness of the bank and non-bank entities in the US to intermediate capital to the extent they had done prior to the crisis. As there is a similar situation in the UK, the increase in the money supply may not directly benefit the UK in the form of higher domestic spending by households and businesses. At the same time, a large proportion of the increase in high-powered money is in the form of short-term loans, hence, it is recognized that many of them will run off on their own as the crisis subsides (Cogley, 2010).

Hence, the evolution of broader monetary aggregates confirm that although UMP has led to a rapid surge in monetary bases, the growth in broader monetary aggregates has been far more contained. As such, it is considered them as not inflationary, at least in the short run (Alexandraki and Martini, 2009). Also, as the Fed currently pays interest on reserves, the ratio of excess returns to the monetary base is considered as unlikely to return to 'normal' (Cogley, 2010).

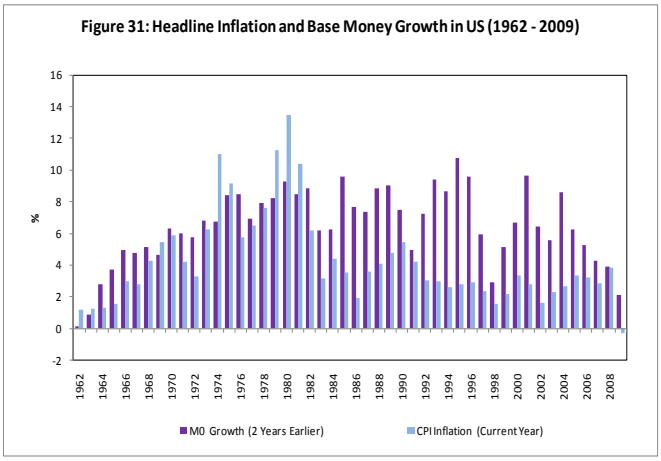


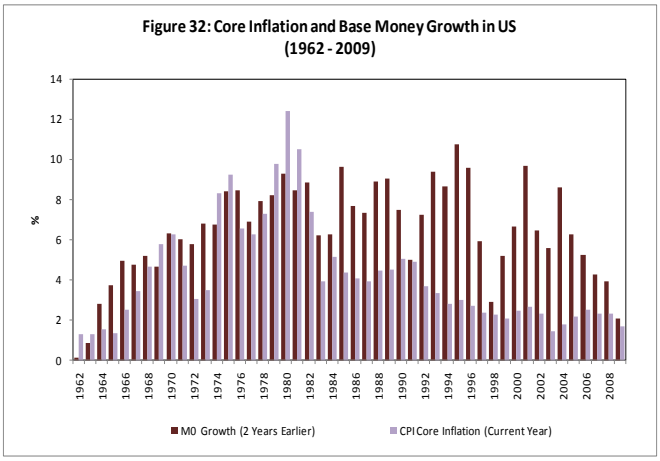
Source: US Fed; BOE

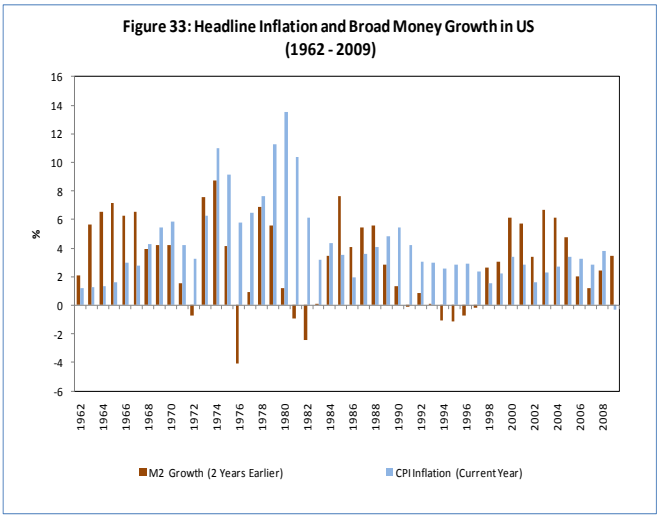
However, most recent data confirm that there is downward trend in excess reserves. This is also confirmed by the turnaround in broad money growth proving that excess reserves held in banks are feeding into additional loans and deposits, thus leading to money creation and hence, possibly pressures on price levels. On the other hand, even the high level of excess reserves continue to remain, theoretical background (as Keynesian standard IS-LM model) suggests, more excess reserves would lead to lower interest rates and, hence, higher aggregate demand and hence, more pressures on prices[19].

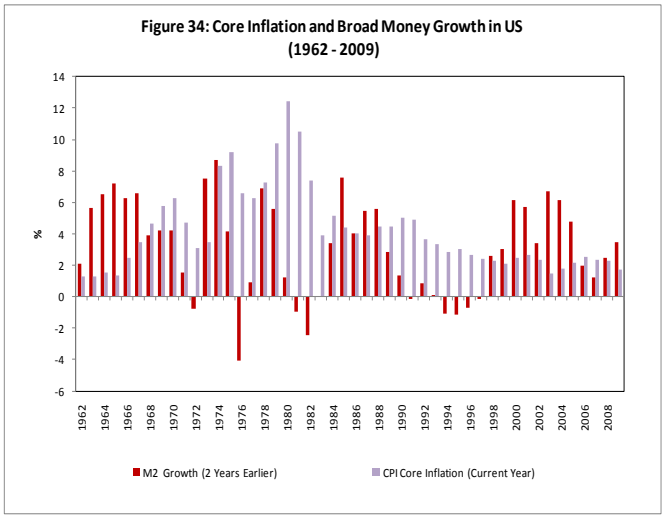
The historical experience prove that there is strong link between base and/or broad money and price levels in countries and the US is no exception. Also, it is clearly proven that every major episode of crisis is followed by subsequent high inflation, and again, this is well proven in the US context. Several years of global recessions (for example: 1993/1998/2002) and several years of recessions in the US (for example: 1980/1991/2001) were followed by episodes of rising price levels.

[19] However, there are counter arguments for this as this claim is rejected on the basis of interest on reserves. When reserves earn interest, the multiplier process will not continue to the point where the market rate of interest is zero. Rather it will stop when the market rate reaches the rate paid by the central bank, since if these rates are the same, banks no longer face an opportunity cost of holding reserves. If the central bank pays interest on reserves at its target interest rate, then banks never face an opportunity cost of holding reserves and the money multiplier would not become an issue. Thus, in this case, the higher level of reserves induces no change in interest rates, and hence, no change in lending behaviour. As a consequence, some argue that large excess reserves may not have a large inflationary effect (for example, see Lavoie, 2010).



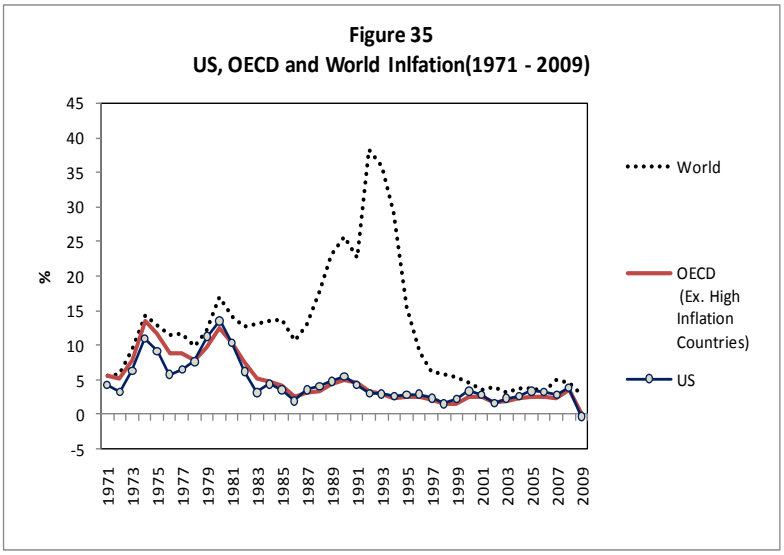






Source: Economic Report of the President of USA, 2009; US Fed

On the other hand, the trends in US price levels was the trend setter of price levels in many advanced and emerging countries, and hence, global inflation.



Note: Emerging economies also follow the same trend. However, the series for emerging economies is not included in the figure due to the outliers during late 1980s and early 1990s

Source: IMF WorldEconomic Outlook Data Base, Thomson Reuters Datastream

Hence, it is not possible and appropriate disregarding the lessons of the history and also the empirical investigations, which point to possible pressures on price levels.

The breakdown in monetary transmission during crises is a typical case (Mohanty, 2009) and also the ineffectiveness of monetary transmission channels is observed in many cases (Bates and Vaugirard, 2009). Estimates of the baseline model indicate that during the pre-crisis period, an unanticipated increase in interest rates affects aggregate economic activity, price levels and money as expected but not during the post-crisis period. The IRFs of the baseline model, which are analyzed through a one-time positive shock to the policy variable (interest rate) by one unit for the pre-crisis and post-crisis periods, support such observations. Since a positive innovation to the interest rate is a contractionary monetary policy shock, the impulse response patterns shown are consistent with the empirical evidence for monetary transmission mechanism. However, such behaviour of output, prices and money cannot be observed during the post-crisis period.

In some cases, the price level responds positively to interest rate innovations in the pre-crisis period. This result, known as the 'price puzzle', is consistent with the empirical literature on monetary transmission. One explanation of the price puzzle is that an unexpected increase in the interest rate increases inflationary expectations thereby increasing the price level (Morsink and Bayoumi, 2001) and its only a temporary situation. A second explanation for the price puzzle is the existence of a 'cost channel' of monetary transmission. An increase in the interest rate increases firms' borrowing costs resulting in an increased price level, especially if the firms depend on short-term borrowing for their working capital needs. However, positive responses of prices during the post-crisis cannot be attributed to prize-puzzles.

Empirical results indicate that typical monetary transmission does not appropriately function during a crisis period. As financial institutions do not respond to interest rates when the economy is flooded with extraordinary amounts of liquidity, hence, interest shocks may not deliver expected results. At the same time, this proves that when economies are operating closer to zero interest rate bound, monetary policy impulses through interest rate shocks show an inability to impact on economic variable in a similar magnitude that of a normal time.

Part V: Exit Strategy of Unconventional Monetary Policies

12. Need for Exit

Although UMP is beneficial in terms of stabilizing financial markets, reducing risk premia and reviving economic activity, there remains a need for existing UMP and refraining from practicing it for a long period given its expansionary impact and harmful effects on transmission processes. This is also persuaded by several other reasons.

Continuation of UMP particularly, QE would generate adverse effects on medium to long-term due to several dimensions of risk. First, continued abundant liquidity in an environment of accommodative

interest rates may ultimately lead excessive risk-taking and a misallocation of resources across the financial sector. Second, a decentralized money market offers the benefit that participants monitor each other and incorporate their assessment of the credit risk of recipients in the price of interbank loans and also proper pricing on counterparty risk. These functions would be affected in a regime of full allotment where all participants can borrow unlimited liquidity from the central bank at a fixed rate. This requires restoring normal liquidity operations as soon as the money market can function on its own. Third, the market discipline may be affected because most participants will draw the lesson from the existing and previous crises that monetary authorities will intervene if turmoil were to occur again in money markets in the future (Minegishi and Cournède, 2010). This may have adverse effects on the sustainability of asset price developments.

From the perspective of macroeconomic stability, UMP measures, if maintained for a prolonged period, could destabilize inflation expectations and thereby inducing inflationary pressures. In a more normal environment where financial intermediation is functioning smoothly and the precautionary demand for liquidity is reduced, the huge accumulation of reserve balances could result in a rapid increase in the aggregate money stock. This in turn could boost aggregate demand and inflationary pressures if there is no spare capacity. The risk of such inflationary pressures in the future can be incorporated in inflationary expectations at present, thereby prompting changes in prices and wages that raise inflation in the near term. In general, while some increases in inflation expectations are not problematic in a situation where actual inflation is low and with looming deflation risks, increases beyond central banks' implicit and explicit targets would be destabilizing. Hence, retaining exceptional policy measures for too long might aggravate the upside risks to price stability and create future imbalances in financial markets.

13. Timing and Process of the Exit

However, any exist strategy needs to follow a gradual and timely process. In this context, the process and the appropriate timing to unwind the extra monetary stimulus has become a major issue in the contemporary discussion. At the fundamental level, when the economy rebounds and inflationary prospects are realigned in line with the central bank's price stability objective, central banks can consider exiting from UMP measures. However, the gradualism is warranted in phasing out such non-standard measures given the continued high uncertainty surrounding the overall financial market situation and this has been practically considered by many central banks (for example: Bernanke, 2010; Trichet, 2010). However, for a number of reasons, formulating an adequate exit strategy is not such an easy task.

Unwinding requires a more cautious approach as central banks required ensuring the stability in financial systems while arresting inflationary pressures. Many central banks, both in advanced (for example, Australia) and emerging economies (for example, India) have started monetary tightening

although many of them followed UMP measures during the crisis. These set examples for other countries, particularly who operates with exploded balance sheets due to extraordinary responses to the crisis. However, the speed of any tightening needs to depend on the maturity of the assets bought by central banks within the framework of their easing programmes. Diversified maturity of assets will ensure that a tightening of the accommodative stance would come in gradual tranches. This is important to avoid any abrupt tightening of credit conditions during the process of the recovery.

At the same time, assets that are longer-term in nature and less liquid could pose challenges to the unwinding. If market conditions were to improve faster than expected, an increase in the average maturity of the central bank's portfolio would make it more difficult for financial markets to return to normal private sector functioning and also subject to future interest rate risk. For example, the Fed currently holds more than US dollars 550 billion in treasury securities. Also, much of the treasury portfolio is long term (US dollars 450 billion for more than 1 year), which are subject to interest-rate risk. When Fed starts selling its assets, yields likely to rise and such situation can expose Fed to capital losses (Colgey, 2010).

On the other hand, exist may signal a round of monetary tightening leading to rise in interest rates in addition to the interest rate risk. If concerns about the required and available amounts of short-term funding still prevailed among market participants, raising rates might reinforce unwarranted upward pressure on overnight rates. Rising interest rates would risk the sustained recovery of money markets, which currently rely on UMP measures. Second, supplying extra liquidity to the markets through UMP measures while, at the same time, tightening monetary policy stance would send mixed signals on the effective monetary policy stance possibly affecting the effective transmission. Also any rise in interest rates may create a complicated situation, because it could undermine competitiveness and amplify foreign-currency borrowing (IMF, 2010a). On the other hand, withdrawing liquidity in large quantities will trigger a substantial contractionary monetary policy shock and it would disrupt the economic recovery or impose heavy losses on lenders.

Given these concerns, monetary accommodation needs to be unwound cautiously. Particularly, since conventional and unconventional policies provide complementary monetary stimulus, the renormalizations of the policy rates and the central banks' portfolio of securities should be coordinated (Rudebusch, 2010). In emerging economies with excessive surpluses, monetary tightening should be supported with nominal effective exchange rate appreciation as excess demand pressures build, including in response to continued fiscal support to facilitate demand rebalancing or in response to capital inflows. Because the recovery in these economies is likely to be faster than expected and than in major advanced economies, emerging countries will probably continue to lead the tightening cycle.

Part VI: Concluding Remarks

Global financial and economic crisis caused substantial changes in the financial and economic conditions across the globe and also resulted in a massive recession. Realising the adversity and magnitude of welfare losses, many authorities stepped in timely manner in order to stabilize markets, systems and hence, economies. Particularly, central banks used their entire weaponry to mitigate the impact of the crisis by way of adopting a blend of conventional and unconventional monetary policy measures. While these policies have contributed restoring financial system stability and mitigating the recession, central banks now face difficulties particularly in maintaining price stability in the medium to long-term and establishing impaired transmission mechanisms with the unusual adjustments in operating instruments and expansions in portfolios. Empirical estimates point to possible pressures on prices in the approaching period due to the restoration of linkages between money, credit and inflation and also with the revival of economic activity. This needs timely and gradual exit strategies while not jeopardizing stability in financial systems and recovery in economies achieved through a range of conventional and unconventional monetary policies and fiscal policies during the crisis.

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Annex I: Data Sources for Modelling*

Country	Variable	Source
US	• Industrial Production Index (US Gross Value of Production – Total Products) • Consumer Price Index (All Urban Consumers) • Base Money (M0) • Broad Money (M2) • Fed Funds Rate	• Thomson Reuters Datastream • Bureau of Labour Statistics • Thomson Reuters Datastream/IFS • Thomson Reuters Datastream/IFS • Thomson Reuters Datastream
UK	• Industrial Production Index (All Production Industries) • Consumer Price Index (CPI Index – All Items) • Base Money (M0) • Broad Money (M4) • Sterling Overnight Interest Rate	• Thomson Reuters Datastream • IFS/ Thomson Reuters Datastream • IFS/BOE Website • IFS/BOE Website • Thomson Reuters Datastream
EU	• Industrial Production Index (Manufacturing) • Consumer Price Index (Harmonized CPI) • Base Money (M1) • Broad Money (M2) • Overnight Money Market Rate	• Thomson Reuters Datastream • IFS/ Thomson Reuters Datastream • Thomson Reuters Datastream/ECB Website • Thomson Reuters Datastream /ECB Website • IFS/Thomson Reuters Datastream
Japan	• Industrial Production Index (Manufacturing) • Consumer Price Index (National) • Base Money (M0) • Broad Money (M2) • Uncollateralized Call Money Rate	• Thomson Reuters Datastream • IFS/ Thomson Reuters Datastream • Thomson Reuters Datastream • Thomson Reuters Datastream • IFS/Thomson Reuters Datastream

* Checked for consistency between different databases

Annex II: Dickey-Fuller Test (with Constant and with Trend)

An AR (1) model can be written in the following form:

$$y_t = \rho y_{t-1} + v_t \qquad \text{(A.1)}$$

where v_t are independent random errors with zero mean and constant variance σ_v^2 . It is possible to test for non-stationirity by testing the null hypothesis that $\rho = 1$against the alternative that$|\rho| < 1$, or simply$\rho < 1$. This one sided (lower tail) test can be put into more convenient form by subtracting y_{t-1} from both sides of (A.1) to obtain:

$$\begin{aligned} y_t - y_{t-1} &= \rho y_{t-1} - y_{t-1} + v_t \\ \Delta y_t &= (\rho - 1) y_{t-1} + v_t \\ &= \gamma y_{t-1} + v_t \end{aligned} \qquad \text{(A.2)}$$

where $\gamma = \rho - 1$and $\Delta y_t = y_t - y_{t-1}$. Then, the hypothesis can be written in terms either ρ or γ as follows:

$H_0: \rho = 1 \Leftrightarrow H_0: \gamma = 0$

$H_1: \rho < 1 \Leftrightarrow H_1: \gamma < 0$

The null hypothesis is that the series is non-stationary. In other words, if the null is not rejected, then the series is non-stationary: if the null hypothesis is rejected, that $\gamma = 0$, then the series is stationary.

Adding a constant and a trend, equation (A.1) can be written as:

$$\Delta y_t = \alpha + \gamma y_{t-1} + \lambda_t + v_t \qquad \text{(A.3)}$$

So, the null and alternative hypotheses are $H_0: \gamma = 0$ and $H_1: \gamma < 0$. If the null is not rejected, that $\gamma = 0 (\rho = 1)$, series is non-stationary. If the null is rejected, that $\gamma = 0$, the series is stationary (Hill, et al, 2008).

Unit Root Tests for Stationary Check
(Full Sample: 2000M01 – 2010M06)
Augmented Dickey-Fuller Test
Null Hypothesis: variable has a unit root Exogenous: Constant, Linear Trend
Lag Length: (Automatic based on SIC, MAXLAG=12)

Country	Variable	Level		First Difference	
		t-statistic	p-value	t-statistic	p-value
US	CPI	-1.733676	0.7304	-7.239277	0.0000
	IPI	-2.991112	0.1391	-2.107408	0.0061
	M0	-0.821110	0.9601	-7.734705	0.0000
	M2	-2.001424	0.5945	-7.820726	0.0000
	Overnight Interest Rate	-1.741788	0.7267	-4.585788	0.0317
UK	CPI	-0.657525	0.9734	-9.804753	0.0000
	IPI	-1.263503	0.8919	-21.87320	0.0000
	M0	-2.311713	0.4241	-2.417151	0.0089
	M4	-1.004235	0.9389	-13.05307	0.0000
	Overnight Interest Rate	-1.141533	0.9170	-17.78320	0.0000
EU	CPI	-2.165982	0.5038	-5.843662	0.0000
	IPI	-2.832959	0.1885	-3.129407	0.0142
	M1	-1.990640	0.6004	-10.29327	0.0000
	M2	-2.036487	0.5753	-3.156599	0.0983
	Overnight Interest Rate	-2.352600	0.4025	-3.667762	0.0283
Japan	CPI	-1.843151	0.6777	-9.915905	0.0000
	IPI	-2.837902	0.1868	-4.143898	0.0072
	M0	-1.675981	0.7562	-9.957900	0.0000
	M2	-0.827462	0.9596	-11.76525	0.0000
	Overnight Interest Rate	-2.028482	0.5798	-6.395757	0.0000

Annex III: Cointegration Test

If y_t and x_t are non-stationary I (1) variables, then their difference, or any linear combination of them, such as $e_t = y_t - \beta_1 - \beta_2 x_t$ is expected to be I (1) as well. However, there may be special cases such that $e_t = y_t - \beta_1 - \beta_2 x_t$ is a stationary I (0) process. In this case, y_t and x_t are said to be cointegrated. Cointegration indicates that y_t and x_t share similar stochastic trends, and, since the difference e_t is stationary, they never diverge too far from each other.

To test whether y_t and x_t are cointegrated, it is required to test whether the errors $e_t = y_t - \beta_1 - \beta_2 x_t$ are stationary. Since, it cannot be observed e_t, it is required to test the stationarity of the lease squares residuals, $\hat{e} = y_t - b_1 - b_2 x_t$. Hence, the test for cointegration is effectively a test of the stationarity of residuals. If the residuals are stationary, then y_t and x_t are said to be cointegrated and if the residuals are non-stationary, then y_t and x_t are not cointegrated (Hill et al, 2008).

The test for stationarity of the residuals is based on the test equation:

$$\Delta \hat{e}_t = \gamma \hat{e}_{t-1} + v_t \qquad \text{(A.4)}$$

Where $\Delta\hat{e}_t = \hat{e}_t - \hat{e}_{t-1}$. t statistic is examined for the estimated slop co-efficient and checked against critical values. The null and alternative hypotheses in the test for cointegration are:

H_0: series are not cointegrated $\Leftrightarrow$ residuals are non stationary

H_1: series are cointegrated $\Leftrightarrow$ residuals are stationary

Similar to the one-tail unit root tests, the null of no cointegration is rejected if $\tau \leq \tau_c$ and null is not rejected if $\tau > \tau_c$, hence, the series are not cointegrated.

The cointegration between variables were estimated using EViews 7.0. EViews supports VAR-based cointegration tests using the methodology developed in Johansen (1991, 1995) performed using a Group object or an estimated VAR object.

A VAR of order ρ is given in the following form:

$$y_t = \mathrm{A}_1 y_{t-1} + \cdots + \mathrm{A}_p y_{t-p} + Bx_t + \varepsilon_t \qquad \text{(A.5)}$$

Where y_t is a k - vector of non-stationary I (1) variables, x_t is a □ – vector of deterministic variables, and □□ is a vector of innovations. The VAR can be rewritten as:

$$\Delta□_□ = \Pi□_{□-1} + \sum_{□=1}^{□-1} \Gamma_□ \Delta□_{□-□} + □□_□ + □_□ \qquad \text{(A.6)}$$

where:

$\Pi = \sum_{□=1}^{□} \mathrm{A}_□ - □$, $\Gamma = \sum_{□=1}^{□} \mathrm{A}_□$

Granger's representation theorem asserts that if the coefficient matrix Π has reduced rank □ < □, then there exist □ ∗ □ matrices □ and □ each with rank □ such that $\Pi = \alpha□'$ and $□'□_□$ is I(0). □ is the number of cointegrating relations (the cointegrating rank) and each column of □ is the cointegrating vector. The elements of are known as the adjustment parameters in the VEC model. Johansen's method is to estimate the Π matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of Π (Quantitative Micro Software, 2009).

Cointegrattion Test for Long-term Relationship Check
(Full Sample: 2000M01 – 2010M06, Trend assumption: Linear deterministic trend, Tables Truncated)

US

Series: CPISA IPISA M0SA M2SA ONINTERESTRATE

Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.337844	96.14060	69.81889	0.0001
At most 1	0.194577	46.25791	47.85613	0.0701
At most 2	0.089385	20.07497	29.79707	0.4178

At most 3	0.066559	8.745061	15.49471	0.3895
At most 4	0.003389	0.410824	3.841466	0.5216

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.337844	49.88269	33.87687	0.0003
At most 1	0.194577	26.18294	27.58434	0.0747
At most 2	0.089385	11.32991	21.13162	0.6144
At most 3	0.066559	8.334237	14.26460	0.3458
At most 4	0.003389	0.410824	3.841466	0.5216

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

UK

Series: CPISA IPISA M0SA M4SA ONINTERESTRATE

Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.484864	159.7871	69.81889	0.0000
At most 1 *	0.290417	79.52479	47.85613	0.0000
At most 2 *	0.183591	38.01242	29.79707	0.0045
At most 3	0.066195	13.46874	15.49471	0.0987
At most 4 *	0.041920	5.181736	3.841466	0.0228

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.484864	80.26229	33.87687	0.0000
At most 1 *	0.290417	41.51236	27.58434	0.0004
At most 2 *	0.183591	24.54369	21.13162	0.0159
At most 3	0.066195	8.287002	14.26460	0.3503
At most 4 *	0.041920	5.181736	3.841466	0.0228

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

EU

Series: CPISA IPISA M1SA M2SA ONINTERESTRATE

Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.324165	145.6125	69.81889	0.0000
At most 1 *	0.315442	98.20396	47.85613	0.0000
At most 2 *	0.307506	52.34710	29.79707	0.0000
At most 3	0.062871	7.884938	15.49471	0.4778
At most 4	0.000231	0.027927	3.841466	0.8672

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.324165	47.40855	33.87687	0.0007
At most 1 *	0.315442	45.85686	27.58434	0.0001
At most 2 *	0.307506	44.46216	21.13162	0.0000
At most 3	0.062871	7.857011	14.26460	0.3934
At most 4	0.000231	0.027927	3.841466	0.8672

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Japan

Series: CPISA IPISA M0SA M2SA ONINTERESTRATE

Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.307055	99.31826	69.81889	0.0000

At most 1 *	0.153124	54.93491	47.85613	0.0094
At most 2 *	0.131138	34.82463	29.79707	0.0121
At most 3 *	0.117641	17.81556	15.49471	0.0220
At most 4	0.021838	2.671664	3.841466	0.1021

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.307055	44.38335	33.87687	0.0020
At most 1	0.153124	20.11027	27.58434	0.3336
At most 2	0.131138	17.00907	21.13162	0.1716
At most 3 *	0.117641	15.14390	14.26460	0.0362
At most 4	0.021838	2.671664	3.841466	0.1021

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Annex IV: Chow's Breakpoint Test

The idea of the breakpoint Chow test is to fit the equation separately for each subsample and to see whether there are significant differences in the estimated equations. A significant difference indicates a structural change in the relationship. Hence, the Chow breakpoint test examines whether there is a structural change in all of the equation parameters. To carry out the test, data should be partitioned into two or more subsamples. Each subsample must contain more observations than the number of coefficients in the equation so that the equation can be estimated. The Chow breakpoint test compares the sum of squared residuals obtained by fitting a single equation to the entire sample with the sum of squared residuals obtained when separate equations are fit to each subsample of the data.

Test statistics for the Chow breakpoint test indicate whether there are any breaks. The F-statistic is based on the comparison of the restricted and unrestricted sum of squared residuals and in the simplest case involving a single breakpoint, is computed as:

$$F = \frac{(\tilde{u}'u-(u_1'u_1+u_2'u_2))/k}{(u_1'u_1+u_2'u_2))/(T-2k)} \qquad (A.7)$$

Where, $\tilde{u}'u$ is the restricted sum of squared residuals, $u_i'u_i$ is the sum of squared residuals from sub-sample i, T is the total number of observations and k is the parameters in the equation. This formula can be generalized naturally to more than one breakpoint. The F-statistic has an exact finite sample F-distribution if the errors are

independent and identically distributed normal random variables. The log likelihood ratio statistic is based on the comparison of the restricted and unrestricted maximum of the (Gaussian) log likelihood function.

The log likelihood ratio statistic is based on the comparison of the restricted and unrestricted maximum of the (Gaussian) log likelihood function. The LR test statistic has an asymptotic χ^2 distribution with degrees of freedom equal to $(m-1)k$ under the null hypothesis of no structural change, where is the number of subsamples.

The Wald statistic is computed from a standard Wald test of the restriction that the coefficients on the equation parameters are the same in all subsamples. As with the log likelihood ratio statistic, the Wald statistic has an asymptotic χ^2 distribution with $(m-1)k$ degrees of freedom, where m is the number of sub samples (Quantitative Micro Software, 2009).

Chow Breakpoint Test: 2007M06
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: All equation variables
Equation Sample: 2000M01 2010M06

US

F-statistic	104.2764	Prob. F(5,116)	0.0000
Log likelihood ratio	214.6762	Prob. Chi-Square(5)	0.0000
Wald Statistic	521.3821	Prob. Chi-Square(5)	0.0000

UK

Chow Breakpoint Test: 2007M06
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: All equation variables
Equation Sample: 2000M01 2010M06

F-statistic	11.97254	Prob. F(5,116)	0.0000
Log likelihood ratio	52.43030	Prob. Chi-Square(5)	0.0000
Wald Statistic	59.86271	Prob. Chi-Square(5)	0.0000

EU

Chow Breakpoint Test: 2007M06
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: All equation variables
Equation Sample: 2000M01 2010M06

F-statistic	28.42974	Prob. F(5,116)	0.0000
Log likelihood ratio	100.7932	Prob. Chi-Square(5)	0.0000
Wald Statistic	142.1487	Prob. Chi-Square(5)	0.0000

Japan

Chow Breakpoint Test: 2007M06
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: All equation variables
Equation Sample: 2000M01 2010M06

F-statistic	26.48275	Prob. F(5,116)	0.0000
Log likelihood ratio	95.94970	Prob. Chi-Square(5)	0.0000
Wald Statistic	132.4138	Prob. Chi-Square(5)	0.0000