

AN ANALYTICAL ASSESSMENT ABOUT POST-GREAT  
MODERATION CENTRAL BANKING POLICIES

A Master's Thesis

by  
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September 2012

*To My Family*

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Graduate School of Economics and Social Sciences  
of  
İhsan Doğramacı Bilkent University

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in

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ANKARA

September 2012

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Economics.

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## ABSTRACT

### AN ANALYTICAL ASSESSMENT ABOUT POST-GREAT MODERATION CENTRAL BANKING POLICIES

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In this thesis, by focusing on the unconventional monetary policy measures, I have analytically assessed post-great moderation central banking policies and documented the heterogeneity in calibration and design of these policies by exposing the experiences of Japan, United States, United Kingdom and Brazil. Moreover, by estimating a structural vector autoregressive (SVAR) model, I have empirically investigated the macroeconomic effects of unconventional monetary policies. Empirical findings of this study suggest that, unconventional monetary policies have lead a temporary increase in GDP and CPI for United States and United Kingdom while its effects are slightly significant for Japan and diametrically insignificant for Brazil.

Keywords: Monetary Policy, Unconventional Monetary Policy, Financial Crisis, Central Banking

## ÖZET

### BÜYÜK İLİMLİLİK SONRASI MERKEZ BANKACILIĞI POLİTİKALARININ ANALİTİK ÇÖZÜMLEMESİ

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Bu tezde, geleneksel olmayan para politikası araçları üzerine yoğunlaşarak büyük ılımlılık dönemi sonrası merkez bankacılığı politikalarının analitik bir analizi yapılmıştır. Japonya, Brezilya, ABD ve İngiltere merkez bankalarının tecrübeleri incelenerek söz konusu geleneksel olmayan para politikalarının tasarlanmasında ve uygulanmasında ülkeler arası bir ayrışıklık tespit edilmiştir. Bunun yanında, yapısal bir vektör otoregresif model kullanılarak geleneksel olmayan para politikası araçlarının makroekonomik dinamikler üzerine etkisi ampirik olarak sorgulanmıştır. Ampirik bulgular geleneksel olmayan para politikalarının ABD ve İngiltere'nin fiyat ve GSYH dinamikleri üzerinde geçici pozitif bir etkiye sahip olduğunu göstermiş, ayrıca bu politikaların etkinliklerinin Japonya dinamikleri üzerinde ancak marjinal anlamlılık düzeyine sahip olduğu, Brezilya için ise tamamen anlamsız olduğu sonucuna varmıştır.

Anahtar Kelimeler: Para Politikası, Geleneksel Olmayan Para Politikası, Finansal Kriz, Merkez Bankacılığı

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## CHAPTER 1

### INTRODUCTION

Prior to the financial crisis, implementation of monetary policy was quite straightforward. In mid-1980's, world have experienced a period with a reasonable decline in output and inflation volatility. Kim and Nelson (1999), McConell and Perez-Quinas (2000) and Blanchard and John Simon (2001) have referred this period as "Great Moderation". During this period, Central banks have enjoyed a golden era until the recent financial crisis. Lower volatility of inflation improved market functioning, made economic planning easier and reduced the resources devoted to hedging inflation risks (Bernanke, 2004). With such a smooth economic environment, sustained anti-inflationary monetary policies actually worked. During the Great moderation, monetary policy implementation across countries had a consensus where short term interest rate was the main policy stance. By the end of Great Moderation, many central banks were formal inflation targeters while many others behaved as inflation targeters despite they claimed they were not. However, after financial crises conjuncture has dramatically changed. Great moderation which has long expansions and short recessions has collapsed with the crisis. Financial crisis acted as a negative aggregate demand

shock which obligated central banks to adopt expansionary monetary policies. As a consequence of these policies, inflation forecasts and policy rates are sharply reduced.

Figure 1a shows the policy rates for selected advanced countries between the periods January 2006 - February 2012. As observed from the graph, after September 2008, in almost all advanced countries central banks have reduced policy rates up to zero point as a response to the negative aggregate demand shock caused by the financial crisis. Similarly, in emerging countries, in order to ease the monetary policy, short term interest rates were also reduced significantly. Figure 1b reports short term interest rate dynamics for selected emerging countries. However, although emerging countries have also reduced their policy rates, they did not face with the zero lower bound unlike the advanced countries. This was an important milestone in the collapse of the previous consensus on monetary policy, since from that date forward, neither conventional monetary policy tools, i.e, short term policy rate was an applicable instrument for all central banks nor stable and low inflation was the primary mandate of all. Thus, over 20 Inflation Targeter countries have started to pursue new approaches to overcome the negative effects of the financial crisis by bearing in mind their own distinctive circumstances and started to use unconventional monetary policies in order to obtain further monetary stimulus.

When traditional monetary policy has reached its limits, advanced countries have injected outstanding amounts of liquidity to the economy in order

to heal the financial sectors. As a result, the size of the balance sheets of Federal Reserve and Bank of England has tripled while the size of the balance sheet of the Euro Area has doubled. Similarly, Swiss National Bank and the Swedish Riskbank have significantly expanded their balance sheets. Bank of Japan has also increased the size of its balance sheet as a response to the crisis. However, this increase remained limited until March 2011. After March 2011, Bank of Japan started to increase its monetary base aggressively. Figure 2 reports the monetary base accretions for selected countries.

While performing these policies, the main concerns that are needed to be taken into consideration for advanced economies were the risk of falling into a liquidity trap and being at the zero lower bound on interest rate. Because if the nominal interest rates were initially low altogether with the actual and expected inflation, policy rates cannot be reduced by central banks any further. At this point, increasing the monetary base beyond the satiation point of the economy becomes ineffective and liquidity trap occurs.

However, for emerging countries, liquidity trap and zero lower bound on interest rates were not practical concerns. In fact, due to their stronger financial systems, the starting points of interest rates and core inflation rates were much higher than the advanced countries. Figure 3a shows the difference between the interest rates of emerging countries and advanced countries. From the graph, we can see that emerging markets have adopted unconventional monetary policies under much higher nominal interest rates in contrast to the advanced economies which indicate emerging countries have higher

growth rates and higher inflation. Figure 3b establishes the truth of this statement. From Figure 3b, we observe that although both advanced and emerging countries have experienced a reduction in their core inflation rates, emerging countries did not go into a deflationary spiral since their core inflation level were initially higher.

In fact, the damnation of emerging market economies was completely different. Due to the shock, huge capital inflows to the emerging countries has reversed and financing conditions has tightened while liquidity in domestic money market and foreign exchange has reduced in magnitude. As a result, emerging markets have experienced sharp depreciation in their currencies. In order to provide liquidity in domestic money market and foreign exchange, central banks started to adopt extensive liquidity provision policies. For example, Brazil and Mexico have supplemented their foreign reserves by opening a currency swap line with the FED. However, although they have widely used liquidity provision policies by providing both domestic liquidity and foreign exchange, they did not employ credit easing and quantitative easing policies. Thus, the types of unconventional monetary policies adopted by emerging countries remained much more limited.

Overall, post-crisis conjuncture of the central banking reveals that what was acquired during the great moderation is lost now. Financial crisis has unhooked central banks from the one policy, one mandate era and obligated them to review their implementation frameworks and to experience new policies that they have not tried out before. As little is known about the nature



and effectiveness of unconventional monetary policy tools, instrumentality of utilizing them has become the focus of much heated controversies.

Against this background, in order to address this knowledge deficiency, in this thesis I will try to analytically assess post-great moderation central banking policies based on the experiences of US, UK, Japan and Brazil. Following that, based on these four countries, I will examine the effects of unconventional monetary policies on economic activity and prices by specifically focusing on balance sheet policies.<sup>1</sup>

Outline of this thesis as follows: In Chapter 2, I will give a theoretical framework for unconventional monetary policies with an emphasis on the balance sheet policies. In Chapter 3, I will give the short history of monetary policy implementation in US, UK, Japan and Brazil and document the heterogeneity in design and calibration of balance sheet policies in these four countries. In Chapter 4, by employing a structural vector autoregression (SVAR) model, I will investigate the macroeconomic effects of unconventional monetary policies based on the data of these four countries. Finally, In Chapter 5, I conclude after some concluding remarks.

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<sup>1</sup>Note that the term "unconventional monetary policy" encompasses other types of unconventional policies, such as conditional statements, which are not covered here.

## CHAPTER 2

### THEORETICAL FRAMEWORK FOR UNCONVENTIONAL MONETARY POLICIES

In this chapter, I will give a theoretical framework for unconventional monetary policies. Along with the general usage of these policies, the main focus will be on balance sheet policies. First, I will provide a general classification for unconventional monetary policies as given in the literature. Second, I will elaborate and contrast the balance sheet policies.

#### 2.1 General Classification of Unconventional Monetary Policies

After the financial crisis that took place in August 2007, the monetary policy actions that eligible to stimulate the economy are the so called unconventional monetary policy tools. These policies have altered the role undertaken by central banks as financial intermediaries which contributes the predictability of the consequences of this kind of policy stance negatively.

Much of the current literature on unconventional monetary policies leans against the Krugman, Dominquez and Rogoff (1998). As an escape route from liquidity trap, they suggested that central banks should try to raise

the market's expectations about future inflation. By this way, real interest rates would be able to bring down sufficiently to stimulate aggregate demand.

Similarly, Bernanke and Reinhart (2004) argued forward policy guidance about the future path of policy rates as a compatible policy measure in the face of zero lower bound. Moreover they divide unconventional monetary tools that can be adopted in such an environment into three main categories:

1. Providing assurance to investors that short rates will be kept lower in the future than they currently expect.
2. Increasing the size of the central bank's balance sheet beyond the level needed to set the short-term policy rate at zero.
3. Changing the relative supplies of securities in the market place by altering the composition of the central bank's balance sheet.

Among these three alternatives, the most interesting tools are the balance sheet policies because after financial crisis, monetary policy actions undertaken by the central banks were widely associated with significant increases in central bank balance sheets. Against this background, when they provide a classification for unconventional monetary policies, Borio and Disyatat (2009) mainly focused on balance sheet policies and even defined unconventional monetary policies as those where the central bank actively uses its balance sheet to affect market activity. Furthermore, they have classified balance sheet policies under three subclasses:

1. Credit policy

2. Quantitative Easing

3. Exchange rate policy

Table 1 shows the type of balance sheet policies adopted by selected central banks. In the subsequent sections, I will discuss and document the concepts of Credit Easing, Quantitative Easing and Exchange Rate Policy in detail. Moreover, in order to address the difference between liquidity management policies and Quantitative and credit easing policies, I will address direct liquidity injections as a separate unconventional monetary policy option and describe it in detail.

## **2.2 Credit Easing**

Central banks' balance sheets are composed of various kinds of assets. Thus, if different types of securities are not perfect substitutes for investors, central banks can influence the relative security prices by changing the composition of their balance sheets. Because when they alter the composition of their balance sheets, the relative supply of securities held by the public changes and changes in the relative demand and supply affect relative security prices. Thus, by altering the composition of its balance sheet, a central bank can control the yields of financial assets (Bernanke et al. 2004).

The term of credit easing is used to denote such policies. In credit easing, in order to change the composition of the private sector balance sheets, central banks change their incurrence to private sector claims. Thus by this

channel government can affect the real activity of the economy. Borio and Disyatat (2009) suggest that credit easing policy can be employed through modifications of collateral, maturity and counterpart terms, or by providing loans and acquiring private sector claims. Moreover, Fed, Bank of England, European central bank, Bank of Japan and many other central banks have widely used credit policies which include broadening eligible collateral and counterparty coverage, lengthening the maturity of refinancing operations and establishing inter-central bank swap lines in order to overcome funding pressures in dollar funding offshore markets. Central banks can implement two different types of credit easing:

1. Sterilized credit easing
2. Unsterilized credit easing

When implementing sterilized credit easing, central banks compensate the rise in their monetary bases by selling an equal amount of their assets. On the other hand, as I will explain in the next section, unsterilized credit easing does not much differ from quantitative easing. In this case, credit easing causes a substantial increase in the amount of excess reserve balances. However essentially, in both types of credit easing, the ultimate aim of credit easing was not increasing the bank reserves.

### **2.3 Quantitative Easing**

In quantitative easing, central banks increase money supply in order to finance their asset purchases. After the implementation of this policy, monetary base and reserve balances remain excessively increased. Nevertheless,

it is possible to find many alternative definitions for quantitative easing. On the one hand, Bernanke et al (2004) characterizes quantitative easing as policies which expands the central banks' balance sheets by increasing the size of reserve deposits beyond the level that is required to bring policy rate to zero. On the other hand, Bank of England's characterization for quantitative easing is slightly different than that. According to Bank of England, quantitative easing is a monetary policy tool in which central banks purchase both public and private assets by financing their actions with central bank money (Benford et al. 2009). Additionally, there are other country specific definitions available in the literature.

However, although the presence of immense number of different definitions of quantitative easing, the coordinating point of these definitions is quantitative easing always increases the reserve balances and monetary base. Borio and Disyatat (2009) have suggested two ways of implementing quantitative easing:<sup>2</sup>

1. Paying interest on reserve balances that depository institutions hold
2. Engaging in offsetting operations that sterilize the impact of the operations on the amount of bank reserves.

Besides, possible transmission mechanism of quantitative easing is also vehemently discussed in the literature as the empirical findings on the effects of quantitative easing on economic activity and prices remain uncertain.

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<sup>2</sup>It is important to notice that such "balance sheet policies" can be executed independently of interest rate policies as long as central bank has the means to decouple the two policies. These types are the ways of achieving this.

Bernanke and Reinhart (2004) have argued that quantitative easing policies are complementary to communication policies in effecting the expectations about future inflation and policy rates as quantitative easing is an indicator for the central banks intention of holding the short term nominal interest rate at zero. Because, when central banks keep bank reserves at a higher level than necessary to keep the interest rate at zero in the future, market participants perceive this as a promise to keep policy rate at zero.

According to Borio and Disyatat (2009), this kind of unconventional policy affects economic activity through three channels. First it has portfolio balance effect. Second, it helps to provide a stronger signal of the central banks' commitment to zero interest rate policy. Third, it helps to provide a permanent increase in money supply which can reduce the expected value of the government's debt costs and thus expected value of the future tax payments reduced. Most famously, Bank of Japan has implemented quantitative easing between the periods April 2001 and March 2006 by switching its short term interest rate target. Again after the crisis, the Bank of Japan has increased its purchases of Japanese government bonds. Moreover both Bank of England and Fed performed purchases of government debt in sizeable amounts.

## **2.4 Exchange Rate Policy**

When classifying balance sheet policies, unlike the other articles with the same objective, Borio and Disyatat (2009) do not only consider the unconventional monetary policy options available at the zero lower bound on interest rate. Instead, they provide a broader definition that includes exchange rate policy which is mostly employed by emerging market economies.

Current literature on unconventional monetary policies predominantly has built upon the advanced countries. Consequently, literature on exchange rate policy remains very scarce. In this kind of unconventional policy, the primary objective is to affect the level and volatility of the exchange rate at a given level of the policy rate such that exposure of the private sector to foreign currencies is changed.

Among the leading central banks of emerging market economies, Central Banks of Brazil, Hungary and Mexico have adopted exchange rate policy after the crisis in order to overcome sudden reversals of capital inflows and downward pressure on the exchange rate. Moreover, the Swiss National Bank has used exchange rate policy tools as well.

## **2.5 Liquidity Management Operations**

Following the onset of the financial crisis, in order to ease funding conditions, unblock interbank operations and prevent the financial panic from



becoming widespread, central banks have started to provide short term liquidity to financial institutions by employing unorthodox liquidity management operations.

Practically, depository institutions can get loan in order to cover their short term liquidity shortage in two ways (Allen, Carletti, 2008):

1. By becoming indebted in interbank market
2. By becoming indebted to central bank

In the first option, commercial banks borrow and lend short term liquidity to each other. Demand and supply for liquidity determines the equilibrium interest rate which is called as money market interest rate. In the second option, depository institutions meet the required liquidity directly from the central bank's itself through repurchase agreements, collateralized loans and standing facilities (Klyuev, de Imus, Srinivasan, 2009). Normally, central banks use liquidity management operations for the purpose of reaching a targeted level of short term interest rate. By taking place in such a transaction, central banks reallocate the total liquidity among market participants.

However, under unorthodox conditions, although liquidity management operations are still applicable, the nature of these policies exhibits a considerable change. For example during financial crisis, in order to raise the assurance of the market participants about the provision of liquidity will continue, central banks have lengthened the maturity of their liquidity provision instruments. Moreover, they have increased the number of applicable

collateral and the range of their counterparts.

Nevertheless, an important discrepancy between balance sheet policies and liquidity management operations remains to be highlighted. When central banks inject liquidity into the private sector, monetary base and the amount of central bank reserves increase in magnitude. However, ultimate aim, namely increasing the broad money, cannot be achieved unless banks decide use this extra liquidity to increase the volume of credit. In contrast, by employing quantitative easing and credit easing, central banks can both increase the money supply and monetary base at the same time since both quantitative easing and credit easing are implemented through purchasing securities directly from the private sector. As it will become obvious in the next chapter, this distinction between balance sheet policies and liquidity management operations will become significant due to the deleveraging act took place during financial crisis.

## CHAPTER 3

### UNCONVENTIONAL MONETARY POLICIES IN PRACTICE: CASES OF JAPAN, UNITED STATES, UNITED KINGDOM AND BRAZIL

In this chapter, I will try to document the heterogeneity in the calibration and design of unconventional monetary policies described in Chapter 2 based on four countries' experiences: United States, United Kingdom, Japan and Brazil. Since these heterogeneities in responses of central banks can be attributed to the country specific differences in economic and political environments, I will provide a general overview about the pre-crisis conjuncture and monetary policy regime of each country. Then I will examine how countries have initially responded to financial crisis and how they have practiced unconventional monetary policies in detail. Finally, I will try to demonstrate the differences in the implementation of unconventional monetary policies across countries. Due to the significance of its prior experience with unconventional monetary policies, in the next section, I will start with the case of Japan. Then I will continue with the cases of United States, United Kingdom and Brazil. Finally, I will provide an overall assessment and then conclude.

### **3.1 Case of Japan**

Before the financial crisis took place in 2007, due to its everlasting deflationary episodes, Bank of Japan was the first central bank who appealed to the help of unconventional monetary policy measures in order to achieve sustained economic recovery. Also, current conjuncture reveals that majority of the advanced economies have fallen into fear of trapping into a deflationary spiral like in Japan. Thus, it is important to examine the Japan's monetary policy regime during 2001-2006 periods as it underlies any study which aims to examine financial crisis and unconventional monetary policies. Thereafter, I will briefly give the economic conjuncture of Japan before I proceed to the Japan's Past experience with unconventional monetary policies.

#### **3.1.1 Pre-Crisis Economic Conjuncture in Japan**

During 1990s, Japanese financial sector started to have a gripping pain due to the bursting of asset bubble which leads a sharp reduction in commercial real estate prices. After the blast, functioning of credit market has been devastated as reduction in real estate prices has tightened the liquidity constraints and escalated the number of available collaterals. In such a distressed environment, banks started to loose capital and private sector started to deleverage by resulting immense losses in economic activity. Figure 4 shows the development in gross domestic product (GDP) during the period between 1990 and 2012.

In order to heal the deteriorating financial sector, stimulate economic activity and escape from the deflationary pressures, initially, Bank of Japan started to ease its monetary policy stance by utilizing conventional monetary policy tools. As reported in Figure 4, policy rate was reduced from 6 percent to 0.5 percent only in four years. However, since macroeconomic conditions were not able to ameliorated, in 1999, Bank of Japan has announced its famous zero interest rate policy (ZIRP) by reducing its policy rate up to 0.02 percent.

Besides ZIRP, Bank of Japan has increased its liquidity provision to the financial institutions by implementing various types of liquidity management operations. In order to revive the credit market and thus enabling economic activity, BoJ has lengthened the maturity of credits and widened the acceptable range of approved collaterals and counterparts as they started to accredit commercial papers and asset backed securities as suitable collaterals. Moreover, they also have provided liquidity to the financial institutions whenever they needed to ensure financial stability (Baba et al., 2005).

However, despite all these efforts, BoJ could not achieve promoting economic activity. Because, when private sector deleverages in the presence of zero interest rate, economy dives into a deflationary spiral in which economic activity persistently slows due to the attrition in aggregate demand (Koo, 2011). Moreover, under such conditions, if central bank continues to expand its monetary base by the provision of excessive amounts of liquidity, money multiplier turns out to be negative and Keynesian liquidity trap oc-

curs.

Actually, this was the exact case in Japan. As Figure 5 exhibits, as a result of the deleveraging act of households and financial institutions, starting from 1998, increasing monetary base became progressively ineffective on the amounts of broad money and bank lending. In particular, despite all these liquidity injected to the corporate sector, required borrowing act could not be undertaken by financial institutions because financial institutions were considerably occupied by paying debt such that they were not able to borrow (Koo, 2011). Against this background, instead of the private sector, government has undertaken the role of the borrower and has appealed to the means of unconventional monetary policy in order to escape from the deflationary spiral. In the next section I will briefly give an overview of the unconventional monetary policy tools adopted in Japan during 2001-2006 periods by specifically focusing on balance sheet policies.

In March 2001, Bank of Japan has started to implement unconventional monetary policy measures by introducing quantitative easing. The aim of this policy was to attain the bank's operating target of current account balances (CABs) held by financial institutions through purchasing government securities (Berkmen, 2012).

In fact, Japanese quantitative easing consisted of three parts. First, BoJ has released that it would target the outstanding balance of current account balances instead of overnight call rate. Second, in order to reach the

targeted value, BoJ has started to purchase long term Japanese government bonds instead of the short term government debt. Finally, BoJ committed that it would continue to employ these policy measures until economy escapes from deflationary pressures.

After adoption of quantitative easing, in 2001, BoJ has announced that the target for CABs was ¥5 trillion. In 2004, it has raised the target up to ¥35 trillion. Respectively, the amount of monthly outright purchases of long term government bonds has bounced from ¥400 billion to ¥1.2 trillion only in one year (Ito and Mishkin, 2004). After the first year of quantitative easing, Japanese central bank also started to perform monetary policy appliance which alters the composition of BoJ's balance sheet such as purchasing equities held by the commercial banks and asset backed securities of small sized firms (Kimura and Small, 2004). After achievement of the positive core CPI rates, BoJ dismissed quantitative easing in March 2006.

### **3.1.2 Post-Crisis Central Banking Policies in Japan**

After financial crisis hit the economy, Japan has experienced a momentous decline in its real GDP growth rate in 2008 as it descended up to -6.2 percent. However, at variance with the previous episode of severe contraction in economic activity, BoJ did not react to the developments in the financial market by immediately adopting unconventional monetary policy measures. Instead, in order to ease the financial conditions and promote the financial stability, BoJ have started to sign bilateral currency liquidity agreement with

the US and first time in its history, injected foreign exchange into the domestic market (Bernanke, 2009).

Moreover, as BoJ have reduced both target rate and the discount rate up to 0.1 percent and to avert the overnight call rate from falling below the target rate and provide additional liquidity, BoJ introduced complementary deposit facility in which it started to pay interest on excess balances over this rate. Finally, in December 2008, when overnight call rate eventually reached its binding lower bound, once again BoJ has started to adopt unconventional monetary policy measures. However in this time, Japanese central bank has used its balance sheet to effect economic activity by the means much similar to the credit easing policy instead of the quantitative easing.

Onset of the 2009, BoJ increased its outright purchases of commercial papers and BBB-rated corporate bonds as approved collaterals in order to focus on specific sectors. Moreover, BoJ has established complementary deposit facilities in order to provide liquidity to the financial sector (Shirakawa, 2010). However, after the arising fact that these measures were inadequate to meet its expectations, BoJ started to accelerate the recovery by introducing comprehensive monetary easing policy in October 2010. Generally, comprehensive monetary easing policy consists of two subsections:

1. Committing zero interest rate policy until price stability fall in a positive targeted range
2. Introducing a new asset purchase program which includes other types of



assets along with government securities such as exchange-traded funds (ETFs) and real estate investment trusts (REITs)

After the policy measures undertaken by the BoJ, money market conditions eased and economic activity increased. In March and April 2010, Bank of Japan chose to terminate some of the tentative measures such as provision of subordinated loans to banks, special funds-supplying operations that support corporate financing and stock purchases held by financial institutions.

In March 2011, Bank of Japan has sharply increased the size of its balance sheet once again aftermath of the earthquake and tsunami in East Japan as it responded immediately to this disaster and injected ¥15 trillion into the interbank market.

## **3.2 Case of United States**

### **3.2.1 Pre-Crisis Economic Conjuncture in United States**

Federal Reserve Act section 2A clearly defines the Fed's mandate as:  
*“The Board of Governors of the Federal Reserve System and the Federal Open Market Committee shall maintain long run growth of the monetary and credit aggregates commensurate with the economy's long run potential to increase production, so as to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates.”*<sup>3</sup>

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<sup>3</sup>However, although ensuring and stabilizing low level of inflation is one of the main targets of the Fed, it never announced that Fed is an explicit inflation targeter.

Before the financial crisis, commonly appealed policy tools to control the policy rate were the open market operations (OMOs). Fed was purchasing secondary market securities and conducting repurchase agreements to control monetary aggregates and economic activity thusly. Besides, in order to alleviate the short term funding pressures on depository institutions, Fed was performing discount window facilities by offering specifically primary credit, secondary credit and seasonally credit to large, medium and small sized firms respectively. Moreover, according to the section 13.3 of the Federal Reserve Act, market participants<sup>4</sup> whose failure has the probability of becoming a negative shock for the overall functioning of the economy could be designated and provided liquidity by the Fed (Fleming, 2012). However, in 2006 times, what is called as “normal times” has ended with a distortion emerged in real estate market while housing prices started to decrease. Moreover, in the following year, prices of mortgage-backed securities have begun to fall due to the increasing skepticism about the real value of the assets in real estate market (Reis, 2010). Moreover, as a result general implementation of high levels of securitization, financial institutions started to declare immense losses (Reis, 2010). Thus a mercurial decadence in financial conditions and funding markets has begun.

### **3.2.2 Post-Crisis Central Banking Policies in United States**

Onset of the financial turmoil, as the majority of the central banks, Fed started to aggressively decrease the federal funds rate as a part of its expan-

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<sup>4</sup>Market participants other than the depository institutions such as individuals, partnerships, and corporations.

sionary monetary policy. As it is apparent from Figure 1a, starting from 5.25 percent for the beginning of 2007, Fed has reduced its policy rate up to 0.02 percent by the end of 2008. When policy rate hit to the zero lower bound, Fed started to announce its target rate as a range and committed to keep zero interest rate in the future.

Besides, in order to provide liquidity to the financial institutions, improving financial conditions and stimulate economic growth, Fed supported its interest rate policy by introducing various types of new liquidity and credit programs. In fact, this period of monetary policy can be designated as credit easing since the implementation of this facilities caused considerable increases in central bank balance sheets by altering its composition at the same time. In general, these facilities can be classified as follows:

1. Lending facilities to depository institutions
2. Lending facilities to the other financial institutions and investors
3. Central bank liquidity swaps
4. Support to the specific institutions

More specifically, as a part of the lending facilities to the depository institutions, In December 2007, Fed has introduced the Term Auction Facility (TAF). The main aim was to ease the financial conditions, provide liquidity to financial institutions and unblock the interbank operations. Large sized depository institutions allowed participating in the TAF while TAF has terminated in March 2010 due to the ameliorated conditions in funding market.

To provide liquidity to the financial institutions other than depository institutions, Fed has utilized the primary dealer credit facility (PDCF), term Securities lending facility (TSLF) Commercial paper funding facility (CPFF), asset-backed commercial paper money market mutual fund liquidity facility (AMLF) and money market investor funding facility (MMIFF) and Term Asset-Backed Securities Loan Facility (TALF). Table 2 gives the complete overview of the facilities that the Fed established during the financial crisis. Although these facilities have been administered aggressively in order to be calm the liquidity pressures in financial markets, almost all of these programs have been terminated before 2010.

Liquidity shortages in financial markets were not limited to the United States because interbank market operations were blocked due to the unforeseeable conditions of the world economy. Particularly, emerging market economies were not able to meet the demand for foreign currency in their domestic markets, especially for US dollar. Thus, in order to lend assistance to the foreign central banks in their provision of dollar liquidity to their depository institutions, Fed has signed bilateral currency swap agreements with 14 central banks around the world. The specific target of these swap lines were actually emerging countries however, Fed have also signed bilateral currency swap agreements with some advanced country's central banks such as European Central Bank (ECB), Bank of England (BoE), Bank of Japan (BoJ) and Swiss National Bank (SNB). In a similar fashion to the lending facilities to the financial institutions, liquidity swap facilities have also terminated in February 2010.

However, as I have stated in the previous chapter, when central banks inject liquidity into the private sector, monetary base and the amount of central bank reserves increase. However, ultimate aim, namely increasing the broad money, cannot be achieved unless financial institutions decide to use this extra liquidity in order to increase the volume of credit. Evidently, again as shown in Figure 5, Fed's colossal injections of liquidity to the financial sector failed to increase the amount of available credit for the private sector and achieved only a slight increase in the broad money.

This was a massive admonition of falling into a liquidity trap. Thus, by taking lessons from Japanese experiment with unconventional monetary policies, beginning from 2008, Fed has started to implement quantitative easing policies in order to abstain from falling into a liquidity trap and stimulate economy.

According to Fed's definition of quantitative easing, focus of policy should be on the quantity of bank reserves while the composition of central bank's balance sheet remains unaltered. In contrast, Fed has utilized credit easing policy as a simple liquidity injection tool while the main focus was on composition of the assets that Fed holds (Bernanke, 2009a). In the second half of the 2008, Fed has started to implement quantitative easing by officially labeling it as large-scale asset purchases (LSAPs). Normally, Fed purchase securities through temporary and permanent OMOs. Temporary OMOs are the market operations which include daily liquidity management operations

of Fed such as REPOs or reserve repurchase agreements. On the other hand, permanent open market operations are used to expand the size of Fed's balance sheet by increasing the currency in circulation. After 2008, Fed had utilized permanent open market operations to implement quantitative easing by introducing two types of long term asset purchase program:

1. Agency Mortgage-Backed Securities Purchase Program
2. Purchase of Government Debt

Fed has enforced quantitative easing in two phases. During the period between 2008 and 2010, Federal Open Market Committee (FOMC) has undertaken the first period of quantitative easing (QE1) as announcing that it would increase its purchases of agency mortgage-backed securities (MBS), agency debt and longer-term Treasury securities up to \$1.25 trillion, \$200 billion and \$300 billion respectively. In August 2010, the FOMC has reinforced QE1 by further increasing its long term asset purchases by announcing that it would reinvest the revenue earned from the agency-related securities investments in longer-term treasuries in order to keep the existing dollar stock on its balance sheet (Reis, 2010). Overall, QE1 period has amounted \$1.725 trillion at the end. This amount corresponds to the 12.1 percent of the United States' nominal GDP of 2008 which equals to \$14.3 trillion.<sup>5</sup>

After the completion of QE1, FOMC undertook a second quantitative easing period (QE2) between November 2010 and June 2011 by purchasing \$600 billion of long-term treasuries. The total amount of additional QE2

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<sup>5</sup>See Gagnon, Raskin, Remache and Sack, 2011 p.54

purchases brought the total amount of large scale asset purchases to \$2.325 trillion at the end of the 2011. Again this number coincides the 16.3 percent of the United States' GDP of 2008.

### **3.3 Case of United Kingdom**

#### **3.3.1 Pre-Crisis Economic Conjuncture in United Kingdom**

After the foreign exchange rate crisis took place in 1992, Bank of England (BoE) has declared itself as inflation targeter to increase the damaged credibility of the monetary policy actions. However until 1997, BoE has not gained its independency and the authority to implement monetary policy was belong to the Chancellor of the Exchequer while the main occupation of BoE was forecasting inflation and evaluating the past inflation performance through public recommendations (Bernanke et al, 1999). Aftermath of gaining its independence, BoE has undertook the responsibility of designing monetary policy to ensure price stability.

Currently BoE continues to adopt flexible inflation targeting regime. Before the financial crisis, main tools for maintaining the targeted inflation level were conventional interest rate policies.<sup>6</sup> According to current governing law; whenever inflation falls below one percent and goes above three percent, BoE has to send an open letter to the Chancellor which explains the reasons of this variation and the policy actions that are intended to be taken (Bank of

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<sup>6</sup>The inflation target of two percent is a point target, but with “thresholds” on both sides.

England 2010c).

Before financial crisis took place, BoE has noticed the danger posed by the persistently growing macroeconomic aggregates in their open letter to Chancellor. For example, from 2002 to 2007, annual rate of growth of broad money was 10 percent. Moreover, according to OECD's economic outlook report in 2010, volume of credit has increased much more than the nominal income and private lending to the private sector. As a result of this accretion in volume of credit, domestic economic growth expanded causing an immense increment in asset prices. However, after financial crisis hit the economy, the situation has reversed while United Kingdom's GDP has fallen significantly and financial markets has gone under stress. After that, BoE has started to undertake policy actions which include historically colossal liquidity insurances and operations (Fisher, 2009).

### **3.3.2 Post-Crisis Central Banking Policies in United Kingdom**

In the awake of the financial crisis, BoE has lowered the policy rate from 5 percent to 0.5 percent between October 2008 and March 2009 (Figure 1a). Afterwards, the monetary policy committee (MPC) has announced that 0.5 percent as the floor for the policy rate since lowering the policy rate any further would be unreasonable. Because in United Kingdom, most of the lending products was indexed to the policy rate which means lowering the policy rate any further would destroy the lenders' interest revenue and contract the credit market thusly (Meier, 2009).



Besides these policy rate cuts, BoE has started to increase its lending operations as UK banks started to hold extra reserves by increasing their targets by £ 1.1 billion. During September 2007, BoE has injected extra liquidity into the financial sector amounted £9 billion. Moreover, they have increased the target ranges for remunerated reserves aiming to reduce the excess reserves that are held by the commercial banks. Additionally, BoE has started to pay interest on reserve (OECD, 2010).

In normal times, BoE utilize monetary policy through the means of the Sterling Monetary Framework (SMF) such that this framework allows BoE to gain ascendance over the amount of liquidity in order to keep policy rate consistent with the central bank's targets. Generally, liquidity management operations are employed in order to reduce the distortions in the liquidity and payments services of commercial banks by providing short-term liquidity. Before the financial crisis, SMF was consisted of three main elements: Reserve accounts, standing facilities and open market operations (Fisher, 2009). After the crisis BoE started to providing liquidity by extending these facilities. In particular, these extended facilities can be classified as follows:

1. Extended Collateral three-month repo OMOs
2. Special Liquidity Scheme
3. Discount Window Facility
4. Central Bank Liquidity Swaps at the BoE

## 5. The one-week Bank of England Bill

By using these facilities BoE has injected liquidity into economy more than £ 180 billion up to January 2009. In contrast with Fed, the usage of liquidity management facilities by BoE was considerably limited. Again, these facilities were merely the extensions of already existing facilities. Despite the fact that average maturity of reverse repo operations has increased aftermath of the financial crisis, BoE did not interfere in the determination process of the longer term funding market. The only minuscular change has took place in the implementation of 3-month reverse repo operations after the introduction of special liquidity scheme (SLS) as it aimed to ease the interbank funding conditions by increasing the number of acceptable collaterals.

Overall, liquidity management operations that are adopted after financial crisis actually are very different between United States and United Kingdom in their essence. In United Kingdom, liquidity management operations cannot be addressed as credit easing as it was almost affectless in changing the composition of the central bank's assets significantly. Thus, it is obvious that BoE has kept its traditional position while performing liquidity management operations. This reveals that, in opposition to the United States, the main purpose behind the implementation of these liquidity management operations was to heal the unperforming banking system instead of promoting the aggregate demand.

When the policy rate reached its effective lower bound, BoE decided to implement unconventional monetary policy tools in order to achieve the 2

percent CPI inflation target in the medium term. Thus, on March 2009, BoE has introduced the quantitative easing as an asset purchasing program of £75 billion financed by the issuance of the central bank's money. After the declaration of the quantitative easing, BoE has announced that it altered its policy instrument from the short-term interest rate to the quantity of money provided. Moreover, BoE also stated that its policy aim is still reaching to the 2 percent inflation target.

Before the introduction of quantitative easing, BoE has already established Asset Purchase Facility (APF) as a subsidiary of the Bank of England on January 30th 2009. At the beginning, facility has served as sterilized credit easing and supported conventional monetary policy as its objective was to improve liquidity in central markets and increase flow of corporate credit through purchases of high-quality private sector assets. These purchases were initially financed through the issuance of treasury bills. This facility has conducted purchases of commercial paper, corporate bonds, government guaranteed bank bonds, asset backed paper from viable securitization structures, and syndicated loans (Meier 2009, BOE Quarterly Report APF Q1 2009). In February 2009, the BoE started buying unsecured corporate bonds, and started to concentrate on the primary market.

However, after the introduction of quantitative easing, the scope of the Asset Purchase Facility has been enlarged and it became a separate monetary policy tool. Thereafter, In contrast with the previous period, asset purchases regarding this program started to be financed through issuance of

base money instead of Treasury bills. The APF was initially authorized to buy assets up to a total of £150 billion, where £50 billion were designated to private sector assets. However, when total amount of purchased government bonds (gilts) increased up to £198 billion, total amount was later extended to £200 billion which coincides the 14 percent of the UK's GDP for 2010.<sup>7</sup>

After 2010, BoE has started to sterilize its purchases in order to maintain market stability and prevent financial conditions from disturbing the wider economy. In March 2010 the Monetary Policy Committee announced that the full amount of asset purchases would be held at £200 billion. Thus, recently only small, selected and sterilized purchases of corporate debt have been conducted.

### **3.4 Case of Brazil**

When the financial crisis has broken out, its destructive impact on emerging countries was considerably limited due to their strong fiscal and economic conditions. As a result, most scholars and policy makers have focused on the malfunctioning financial markets in advanced countries by considering that emerging countries would be able to perpetuate their strong performance and remain unaffected from the severe negative aggregate demand shocks. Moreover, after the onset of the financial crisis, the main problem for emerging countries was the inflation pressures as capital flows and credit volume ex-

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<sup>7</sup>At the end of the first quarter of 2010, the gilt holdings in the facility amounted to 99 % of total holdings.

panded.

Nevertheless, the failure of the Lehman Brothers in September 2008 has radically changed the status. Emerging countries' economies started to get distressed as the collapse of Lehman Brothers has triggered an immense contraction in credit and capital markets as well as international trade by countries dependent on commodity exports. Against this background, these countries have started to experience significant macroeconomic fluctuations and suffer from the fiscal and external slenderness. In order to overcome this malfunctioning, emerging countries have also expanded their policy tools but different than the advanced economies.

In this context, in order to emphasize this heterogeneity, examining the monetary policy actions of the Brazilian Central Bank (BCB) constitutes a good example as Brazil is one of the world's largest emerging market economies and dominates the market on the South America.

#### **3.4.1 Pre-Crisis Economic Conjuncture in Brazil**

After the blast of major currency crisis in 1999, Brazil has declared itself as an inflation targeter by terminating exchange rate targeting regime in order to prevent massive devaluation of the real as the main mandate of the Monetary Policy Committee (Copom) was to ensure price stability.

After the adoption of the inflation targeting, an immense uncertainty

about the maintenance of the inflation targeting regime has occurred and BCB has mostly suffered from severe exchange rate depreciations, fast economic growth and rapid credit expansions. Consequently, as an export-led economy, Brazil started to deviate from standard inflation targeting<sup>8</sup> by being an implicit exchange rate targeter as it widely intervened in foreign exchange markets and imposed taxes and used other types of controls on international capital flows (Cunha, Ferrari-Filho, Prates, 2011).

In 2007, BCB started to adopt additional fiscal policy tools in order to support the implementation of the Growth Acceleration Program. As a result, BCB has started to give current account surpluses, increase its international reserve accumulations and grow at around 6 percent annually. Moreover, Brazil has started to accomplish substantial trade balances and improved trade situation as a result of the immense capital flows into the economy (IMF, 2006).

Against this background, BCB has met financial crisis under very strong financial system and economic conditions. Consequently, BCB has condescended the omnipotence of the financial crisis and they have taken no extra counter-cyclical movements in order to abstain from the effects of this financial turmoil. Nevertheless, after the reduction by 3.6 percent in GDP for the last quarter of 2008 has been announced, Brazil started to take financial

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<sup>8</sup>In theory, monetary authorities in Brazil, Chile, Colombia, Mexico, Peru, and Uruguay follow the orthodoxy of inflation targeting, which considers that ensuring price stability is the main (perhaps the only) goal of monetary policy and short term interest rates should be the only instrument used to achieve the inflation target while exchange rate should float freely.

crises serious.

### **3.4.2 Post-Crisis Central Banking Policies in Brazil**

After the financial crisis showed its effects on Brazilian economy, significant contractions in liquidity in the interbank market have taken place as companies started to loose exchange derivatives which caused by the devaluation of real. Thus, in order to ease financial conditions, Copom and BCB started to decrease the Selic (Brazil's policy rate) and inject liquidity into the interbank market. As shown in the Figure 1b, the Selic has been reduced from 13.75 percent to 8.75 percent during the period between December 2008 and September 2009.<sup>9</sup>

Additionally, in order to inject extra liquidity into interbank market and refinance the smaller banks, Copom and BCB has started to implement a broad set of policies in order to meet the domestic liquidity demand and credit shortage. More specifically, liquidity in the interbank market has been controlled through:

1. Reserve requirement policies
2. Federal system of public financing characterized by the existence of large and relevant public banks

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<sup>9</sup>Interest rate reductions in Brazil started with delay as the threat of inflation caused by the devaluation of the real was high. Thus the monetary policy conducted by the BCB in the last quarter of 2008 strongly contrasted with the actions of the principal advanced and emerging economies.

In particular, the main aim behind the liquidity injection policies was to entail the financial system stability by solving the liquidity problems of banking system and minimizing the distortions that block the functioning of the credit market by providing credit to non-financial corporations.

In the last quarter of 2008, when Brazilian companies started to suffer from the shortage of liquidity in foreign currency, BCB has started to provide liquidity by utilizing its international reserves (amounted \$205 billion) and sold \$14.5 billion in the spot market. Moreover, in order to alleviate the distressed financial market, BCB has signed bilateral currency swap agreements at a valuation of \$50 billion and injected \$11.8 billion of this swaps into the system through repurchase agreements.

Moreover, BCB started use reserve requirements and discount window facilities in order to increase and reallocate banking reserves and federal public securities liquidity. For example BCB has enlarged the functions of Credit Guarantor Fund (CGF)<sup>10</sup> to solve the liquidity problems of small sized banks while it decreased the amount of reserve requirements and reduced the tax rate on demand and savings deposit to provide liquidity into the whole banking system.

More specifically, as a part of the reduction process in reserve requirements, BCB has injected \$116 billion into financial system, almost 50% of

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<sup>10</sup>The Fundo Garantidor de Créditos (FGC) is a deposit guarantee system that established in 1995 as “a private non-profit organization to control the protection of credit holders against financial institutions”.



the total amount of the required reserves in the period aftermath of the crisis that coincided 4% of the GDP of 2009. Besides, the range of approved collaterals has been increased as BCB started to accept multifarious banking assets as collateral such as loans and private bonds. At the same time BCB has increased its authority to assist the Brazilian financial institutions that writhe in liquidity shortage by permitting to obtain credit portfolios from financial institutions. This permission has been granted through rediscount window facilities.

All these actions have contributed to the competence of the liquidity conditions of financial institutions and specifically, small and medium sized corporations. However, the scope of the actions that are adopted by BCB in order to respond the effects of financial crisis was not limited with liquidity easing measures. In fact, interbank lending activity still remained distorted despite all of this easement in monetary policy stance. Thus, Brazilian government has generated additional measures to normalize credit conditions for non-financial market participants and increase the volume of credit provided by the private banks through controlling public banks namely Banco do Brasil (BB) and Caixa Econômica Federal (CEF) and Banco Nacional de Desenvolvimento Econômico e Social (BNDES).

The role of these three public banks was extremely crucial in terms of preventing further reductions in economic activity and perpetuating the supply of credit to individuals and companies while private banks desired to keep high liquidity. In particular, BB CEF and BNDES have tried to unblock in-

terbank operations by increasing their credit operations, acquiring the problematic small and medium sized institutions' credit portfolios and reducing the loans' interest rates. As a result, according to BCB's reports, their participation on the credit system rose from 33% to 42% during the period between June 2008 and September 2009. Moreover, during this period, the credit provided by these three public banks has increase by 61%.

After that point, Brazilian government has intensively used fiscal policy measures included the stimulus package adopted by the Ministry of Finance, as well as other fiscal measures, which even though are not components of this package, were also important to mitigate the negative impact of the international financial crisis on the economic activity and financial conditions.

### **3.5 Cross-Country Comparison of Post-Crisis Central Banking Policies**

In this section, I will try to analyze and contrast the post-crisis policy responses and implementation of unconventional policy measures of these four countries.

The picture that I have plotted in the previous sections yields that the policy responses from BoJ, Fed, BoE, and even BCB have several common features as all central banks have eased the monetary conditions and by increasing the size of their balance sheets significantly, provide excessive amounts of liquidity into their financial markets in order to revive economic

activity and fix the functioning of the credit markets (Figure 7).

However, as I have tried to point out, there are some serious discriminative features in each country which effect the implementation of monetary policy. In particular, regarding unconventional monetary policy measures, these differences in implementing monetary policy can be characterized into two subgroups: (I) Diversified implementation of the same type of unconventional monetary policy (II) Adoption of different types of unconventional monetary policy.<sup>11</sup>

In particular, the root of the first type of discrepancy can be traced back to the differences in economic structures of these four countries. As I have documented above, central banks of United States and United Kingdom has widely used unconventional monetary policy measures in the form of credit easing and quantitative easing. However, Brazilian central bank has only relied on exchange rate policies and reserve requirements. This is because Brazil has less developed domestic financial system while markets for securities and corporate bonds are much smaller. Moreover, as documented in the first chapter, Brazilian central bank was not obligated to implement quantitative easing and credit easing in order to ease monetary conditions since Brazil faced financial crisis under much solid financial conditions and BCB's policy kit was significantly wider in contrast to the BoJ, Fed and BoE.

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<sup>11</sup>My definition for types of unconventional monetary policy follows Borio and Disyat's classification described in chapter 2.

Other than this, before 2009, it is apparent that the focus of BoJ on unconventional monetary policy measures similarly remained limited compared with Fed and BoE. Before the financial crises, the size of the balance sheet of BoJ was much bigger than the Both Fed's and BoE's balance sheets while the balance sheet of BoJ now is the smallest one among them in terms of bank notes outstanding in August 2009(IMF, 2010b).

The second type of discrepancy becomes obvious when the cases of United States and United Kingdom have been investigated in detail. Despite the fact that both countries balance sheets rose dramatically in scale and they both adopt aggressive quantitative easing policy, the accumulated composition of their balance sheets exhibits immense heterogeneity (Figure 8).

First difference emerges from the relative importance of credit markets in UK and US. As described in sections 3.2.2 and 3.3.2, during financial crisis, Fed has intervened actively in credit markets and focused on broader financial markets and private sector regarding the importance of these markets as a source of finance in the US. However, on the other hand, BoE has particularly avoided from intervening in the credit markets by maintaining its traditional central bank role and it has been actively involved in government bond markets as I have suggested above.

Apart from this, another source of difference is that BoE employs flexible inflation targeting regime with a declared objective of achieving the inflation target of two percent in the medium run. However, Fed did not admit an

explicit gauge as a target of inflation although preserving inflation at low levels is one of the three mandates of the Fed. This represents an institutional difference between the Bank of England and the Federal Reserve.

Overall, against this background, post-crisis policy experiences of these four countries reveal that there is a considerable heterogeneity in design and calibration of unconventional monetary policies. In general, these heterogeneities emerge from country specific objectives and discrepancies in economic and political environments of countries such as structure of their financial systems, institutional arrangements of their central banks and finally the types and origins of the shocks that hit their economy. Also, restricting conditions such as zero lower bound on interest rate and falling into a liquidity trap have fomented these differences much further.

## CHAPTER 4

### ANALYZING THE EFFECTS OF UNCONVENTIONAL MONETARY POLICIES

In this chapter I will explore the dynamic effects of unconventional monetary policy shocks on economic activity and prices. In previous chapters I have stated that there exist heterogeneity in the design and calibration of unconventional monetary policies across countries. Thus, subsequently, an answer to the question “is there any heterogeneity in the effects of unconventional monetary policies on macro economy across countries?” will be investigated based on the four country experiences. The analysis in this chapter will be conducted by estimating a structural vector autoregressive model (SVAR) with monthly data over the sample period 2008 January-2012 February. First, a literature review on the effects of unconventional monetary policies on macro economy will be given. Second, the model and the data will be described. Finally, estimation results will be presented.

#### 4.1 Literature Review

Before the financial crisis, an extensive literature has investigated the impact of the conventional monetary policy tools on real activity and in-

flation. However still, little is known about the macroeconomic effects of the unconventional monetary policies. Thus the literature on the effects of unconventional policies on macro economy continues to expanding since a better understanding of the impact of unconventional monetary policies is essential for the policymakers and needed to construct theoretical monetary models.

Much of the literature that measures the effectiveness of unconventional monetary policies has focused on the advanced economies and the effects of unconventional monetary policies on the financial markets. Christensen et al. (2009), Taylor and Williams (2009) have focused on the effects of central banks' liquidity measures on money market yields in the first stage of the crisis. On the other hand, Hamilton and Wu (2010), D'Amico and King (2010), Wright (2011) has focused on the effects of large scale asset purchases on long-term interest rates and other asset prices.

Despite the fact that estimated quantitative effects of unconventional monetary policies vary across different studies, in general the results of these papers suggest that this kind of policies are effective in lowering financial market yields. Taylor and Williams (2009) have found that Federal Reserve's Term Auction Facility was initially not effective in bringing down money market yields because the effects of the program on total liquidity supply was sterilized by government securities sales. On the other hand, the macroeconomic effects of the unconventional monetary policies have mostly been neglected. There exist few papers that assess the effects of unconven-

tional monetary policies on macroeconomic aggregates. Chung et al. (2011), Lenza et al. (2011), Peersman (2011) have estimated the macroeconomic effects of unconventional monetary policies. However their estimation was based on the models constructed before the financial crisis. Thus, the fallacy of these papers is that their models may not be appropriate to analyze the effects of monetary policy on macro economy during a financial crisis.

In this chapter, in order to overcome with this problem, as in the spirit of Peersman and Smith (2003) and Peersman (2011) a structural vector autoregression model has been adopted to analytically analyze the dynamic effects of unconventional monetary policies on economic activity and prices based on four country's data. In the light of these results, effectiveness of unconventional monetary policies on economic activity and prices has been investigated and the question “are there any heterogeneity in the effects of unconventional monetary policies on macroeconomy across countries?” has been answered.

## 4.2 Specification of the VAR Model

The benchmark specification of the structural vector autoregressive model has the following form:

$$Y_t = \alpha + A(L)Y_{t-1} + B\epsilon_t \quad (1)$$

where  $Y_t$  is a vector of endogenous variables containing variables output  $y_t$ , prices  $p_t$ , level of policy rate  $i_t$  and the monetary base  $m_t$ .  $\alpha$  is a vector



of constants and  $B$  is the contemporaneous impact matrix of the mutually uncorrelated disturbances  $\epsilon_t$ .  $A(L)$  is a matrix polynomial in the lag operator  $L$ . In order to allow implicit co-integrating relationships in the data, all variables except interest rate are in log levels in the spirit of Sims, Stock and Watson (1990).

As we stated clearly in Chapter 3, after financial crisis, main policy instrument became a quantitative aggregate and quantitative rules took place of the interest rate rules (Bullard 2009). Majority of the countries have conducted unconventional monetary policy in the form of outstanding purchases of government securities, i.e., central banks have enormously increased their balance sheets. Thus, in our benchmark model, we simply take unconventional monetary policy as total liquidity injected by central banks to the economy. In my model, the selected indication of total liquidity of central banks is monetary base  $m_t$ . In particular, within this standard framework, the specification of my VAR model implies that balance sheet policies respond to the economic activity, price level and level of the policy rate.

I identify an unconventional monetary policy shock as an exogenous innovation to the central bank balance sheet. In order to identify exogenous balance sheet shock, I imposed zero restrictions on the matrix  $B$ . To this end; I have classified GDP and CPI as non-policy variables and monetary base and interest rate as policy variables. In the line with the existing literature policy variables have no contemporaneous effect on non-policy variables while current developments in the non-policy variables can affect policy variables

contemporaneously. More specifically, I impose zero restriction on contemporaneous effects of monetary base and interest rate on economic activity and prices. On the other hand contemporaneous impact of economic activity and prices on monetary base and interest rate is left completely unrestricted.

VAR equation is estimated over sample period January 2008 - May 2012 with four country's data: United States, United Kingdom, Japan and Brazil. All data were taken from IMF financial statistics database. All variables have monthly frequency and seasonally adjusted. I have used data of industrial production as a proxy for output since monthly data for real gross domestic product were not available.

In order to estimate the SVAR model I have used the econometric package JmulTi. Model is estimated by feasible generalized least squares (GLS). For this purpose, as a first step, individual equations of the systems are estimated by ordinary least squares (OLS) method. As a result, standard impulse response functions have been acquired. Moreover, one standard error confidence bands for the impulse response are generated through bootstrapping technique. I have considered 50 future periods in all estimations.

In choosing a suitable lag length for the SVAR model, I have utilized Schwarz information criterion for the full system of equations. As a simple gauge for the model stability, eigenvalues of the companion matrix of the SVAR model has been checked. According to Schwarz information criteria the optimum lag length is two for all estimations in the model. Thus, I

use two lag lengths for my model as it is sufficient enough to capture the dynamics of the model and does not cause attrition of degrees of freedom. Furthermore, diagnostic tests resulted that, the absolute values of eigenvalues of the VAR companion matrix are all less than unity. Thus, my SVAR model turns out to be stationary and my estimations are stable.

### **4.3 Empirical Results**

In this section, I will present the responses of the economic activity, inflation and interest rate to an unconventional monetary policy shock.

Figure 9, Figure 10 and Figure 11 exhibit the response of economic activity, prices and interest rate to an exogenous innovation in unconventional monetary policy for four countries respectively. The solid lines represent the estimated response while two dashed lines represent the 95 percentile confidence intervals. Broadly, an immediate conclusion that can be derived from the estimation results is that unconventional monetary policies are effective in United States and United Kingdom while its effects only found to be marginally significant in Japan and insignificant in Brazil.

In particular, unconventional monetary policy has a significant positive temporary impact on both economic activity and prices in United States and United Kingdom. On the other hand, in Japan, output reaction becomes only marginally significant after approximately twelve months as from unconventional monetary policy shock while price response is insignificant.

In the Brazilian case, although positive responses are estimated in both economic activity and prices, they unfortunately remain insignificant.

Now, In order to put the estimates into a better perspective, I will compare these estimates with the actual developments in these macroeconomic variables case by case and try to explain the source of differences in the effectiveness of unconventional monetary policies.

#### **4.3.1 Response of GDP to Unconventional Monetary Policy**

Unconventional monetary policies came into effect in 2008 and 2009 in United States, Brazil and United Kingdom, Japan respectively. Figure 6a shows that all four countries output has dampened sharply at the time when unconventional monetary policies first introduced. As I have specified my model accordingly, there is no instant effect of unconventional monetary policies on economic activity. Consistently with the results of the experiment, approximately nine months after the adoption of unconventional monetary policies, real GDPs of United States and United Kingdom start growing as they reach their peak after twelve months. Thus, this amelioration in economic activity in US and UK can be attributed to the effectiveness of unconventional monetary policies adopted during this period. On the other hand, although a significant rise in real GDP of Brazil and Japan is also evident after five months later as from the adoption of unconventional monetary policy measures, empirical results suggest unconventional monetary policies played only a limited role for in Japan and no role in Brazil. In Japan, effects of

exogenous unconventional monetary policy shock become merely significant after ten months and remains significant for approximately ten months as the persistence of the shock on economic activity is considerably low and in Brazil effects of shock on economic activity completely insignificant.

The peculiarity of the Japanese and Brazilian results seems to be due to the fact that these two countries have utilized the unconventional balance sheet policies to a much lesser extent compared with the United States and United Kingdom. As a result, pinning down the effects of unconventional monetary policy shocks is much harder. As I have stated in Chapter 3, after quitting quantitative easing policies in 2006 Japanese central bank have not escalated its balance sheet again until the mid 2009s as its banking sector remained in a relatively better position after the crisis. Thus this can explain the low persistence of policy shock on economic activity in Japan.

For the case of Brazil, apart from the low usage of unconventional monetary policies, the fact that fiscal measures that have been adopted by the Ministry of Finance of Brazil might have hindered the effects of unconventional monetary policies in Brazil. For example in 2009, Ministry of Finance in Brazil has announced a 2 percent Tobin tax which covers investment inflows (except direct inflows) for equity and fixed-income securities. The rationale behind the tax was to defend weakening Brazilian real and encourage the Brazilian industries and exports which caused an appreciation in real by 35 percent and accelerated capital inflows. Thus the sudden accretion in Brazil's economic activity can be ascribed to these types of fiscal stimulus

measures.

### **4.3.2 Response of CPI to Unconventional Monetary Policy**

Figure 6b illustrates the development in consumer price index of four countries. As it is apparent from the figure, The CPI indices had started to decline in all countries already before the adaption of the unconventional monetary policies. Again, significant expansions in the balance sheets of countries had no instant positive effect on inflation rates. Approximately nine months after the adoption of unconventional monetary policies, consumer price indexes started to rise again. This dynamic of consumer price index is compatible with the results of my empirical investigation as it captures a significant effect of policy shock on consumer price indexes of both United Kingdom and United States.

However as Figure 10 exhibits, for US, effect of unconventional monetary policy in prices is much larger than UK in magnitude as one standard deviation increase in unconventional monetary policy leads approximately 0.6 percentage points increase in US's CPI while it leads approximately 0.1 percentage points increase in UK's CPI. One possible reason for this might be the institutional difference between US and UK as being an inflation targeter, the primary mandate of UK is to preserve price stability.

On contrary, along with economic activity, unconventional monetary policy effects on consumer prices in both Japan and Brazil remains insignificant

as well. Besides the factors have been stated in previous section, this insignificance can be explained by the Japan's idiosyncratic conditions regarding the deflation. Because in Japan, due to the prolonged periods of deflation, stable inflation expectations became established stable and Philips curve got flatten while large changes in output is required in order to move inflation.

Overall, based on these results, it can be concluded that unconventional monetary policy measures have a significant positive temporary impact on both economic activity and prices in United States and United Kingdom. Thus, these policies can be effectively utilized by central banks in order to revive economic activity and avoid from the deflation trap. On the other hand, for Japan and Brazil effects of these policy sets are not clear. Under these specifications, unconventional monetary policies seem lacking in effectiveness for these two countries.

A tentative conclusion can be drawn from these observations as they imply that the effectiveness of unconventional monetary policies is subject to cross country heterogeneity along with the differences in its design and calibration across countries. Of course, as the scope of this study is limited with the experiments of merely four countries, evidence suggested by these results is not adequate to arrive at strong conclusions.

## CHAPTER 5

### CONCLUSION

Financial crisis has hit the global economy by terminating the one mandate, one policy instrument era as it has exposed Central Banks to unprecedented challenges. As a result, In order to handle these unprecedented challenges, central banks have embarked upon a series of unconventional policy interventions.

In this thesis, I have analytically analyzed the post-crisis central banking policies and investigated the effects of these unconventional measures by exposing the experiences of Japan, United States, United Kingdom and Brazil. Moreover, I have documented the heterogeneity in design and calibration of these policies across countries and tried to investigate whether this finding is valid for the effectiveness of unconventional monetary policies based on the observations and results obtained from the empirical research. Firstly, in Chapter 2, I have provided a general scope for the theoretical framework of unconventional monetary policies and tried to put policy definitions into a context based on the existing literature.



In Chapter 3, I have provided a general overview about the pre-crisis conjuncture and monetary policy regime of Japan, United States, United Kingdom and Brazil and I have examined how these countries have initially responded to financial crisis and how they have practiced unconventional monetary policies in detail. Finally, I have tried to demonstrate the differences in the implementation of unconventional monetary policies across countries and concluded that these heterogeneities emerge from country specific objectives and discrepancies in economic and political environments of countries such as structure of their financial systems, institutional arrangements of their central banks and finally the types and origins of the shocks that hit their economy.

Unconventional monetary policy tools have been rarely utilized in practice and the credibility of these policy tools is not yet established. Moreover, central banks could not anticipate the consequences of these types of measures as they present greater uncertainty in magnitude compared with conventional monetary policy tools. Thus, in Chapter 4, by estimating a structural vector autoregressive model (SVAR) with monthly data over the sample period 2008 January - 2012 February, I have explored the dynamic effects of unconventional monetary policy shocks on economic activity and prices. As a result, I have empirically documented that unconventional monetary policy has a significant positive temporary impact on both economic activity and prices in United States and United Kingdom while in Japan, output reaction becomes only marginally significant after approximately twelve months as from unconventional monetary policy shock while price response is insignificant

and In the Brazilian case, although positive responses are estimated in both economic activity and prices, they unfortunately remain insignificant. Moreover, based on these results, tentatively I have concluded that there exists cross country heterogeneity in effectiveness of unconventional monetary policies along with the differences in its design and calibration across countries.

To sum up, adoption of unconventional monetary policy measures started a new era in central banking and countries have started to pursue new approaches to overcome the negative effects of the financial crisis by bearing in mind their own distinctive circumstances. As a result, heterogeneity in implementation of unconventional monetary policies has occurred inevitably. In this thesis, I have documented this heterogeneity and concluded that unconventional monetary policies have differentiated effectiveness across countries. However my analysis is limited in scope as I only focused on four countries. Further studies may extend these results by investigating country experiences in much broader terms and increase the precise of their findings about the effectiveness of unconventional monetary policies by adopting a counterfactual analysis.

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## APPENDIX

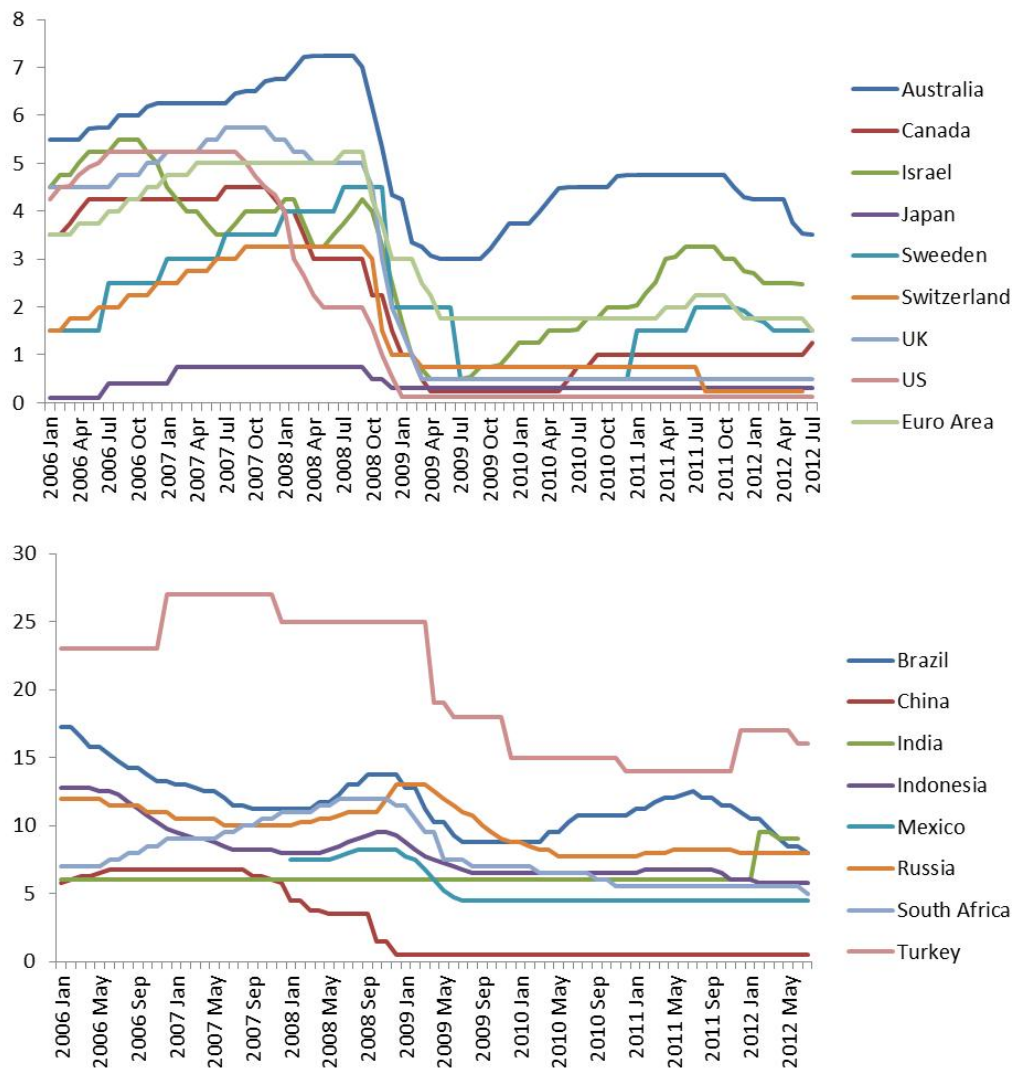


Figure 1: Policy Rate Dynamics of Selected Countries Source: IMF Financial Statistics (IFS). Fig.1a-Policy Rate (Advanced Countries), Fig.1b-Policy Rate (Emerging Market Economies)

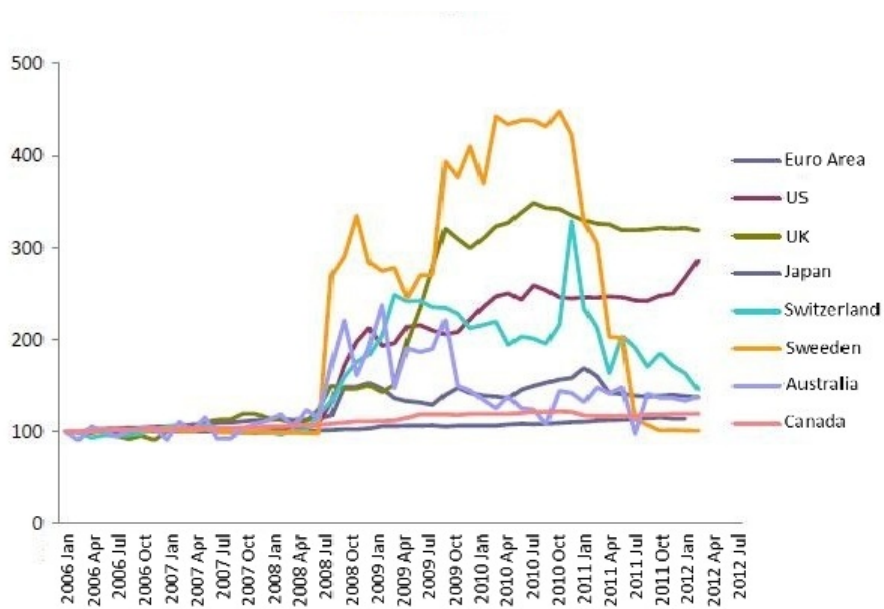


Figure 2: Monetary Base Dynamics of Selected Countries Source: IMF Financial Statistics (IFS)

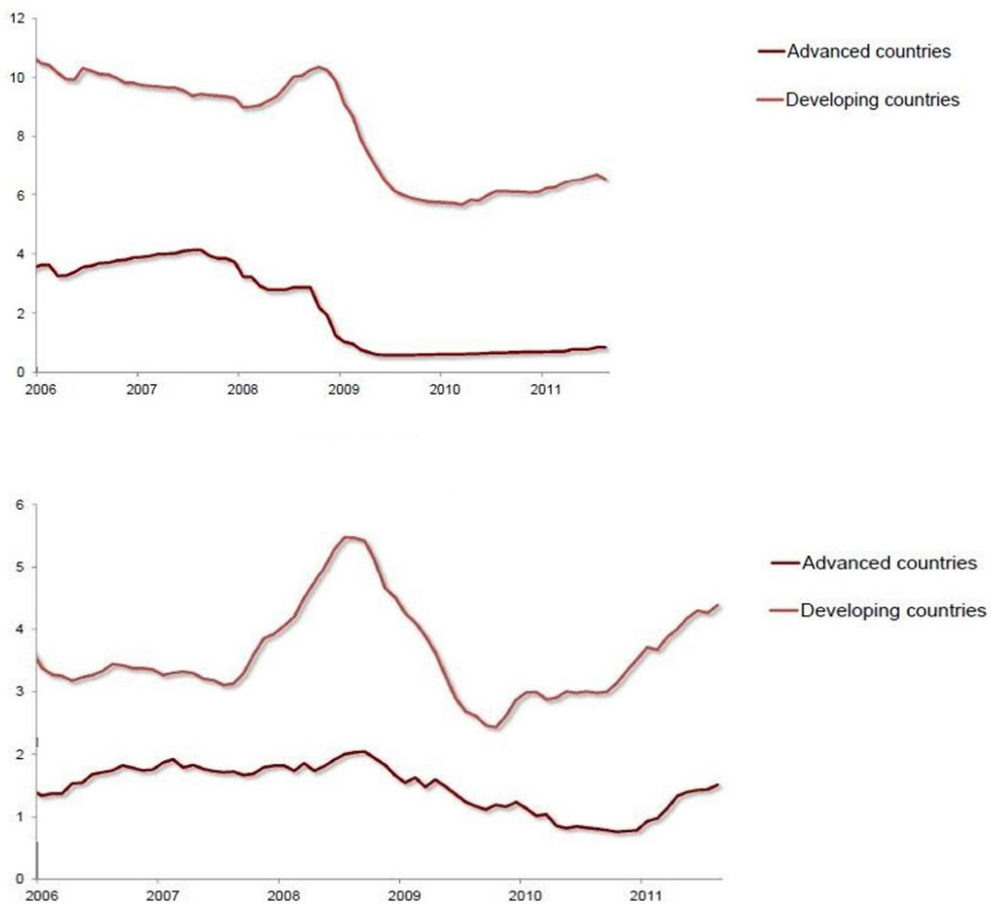


Figure 3: Differences in Key Macroeconomic Variables between Advanced and Emerging Economies Source: Bloomberg, CBRT calculations. Fig.3a- Policy Rate Differences, Fig.3b-Core Inflation Rate Differences.

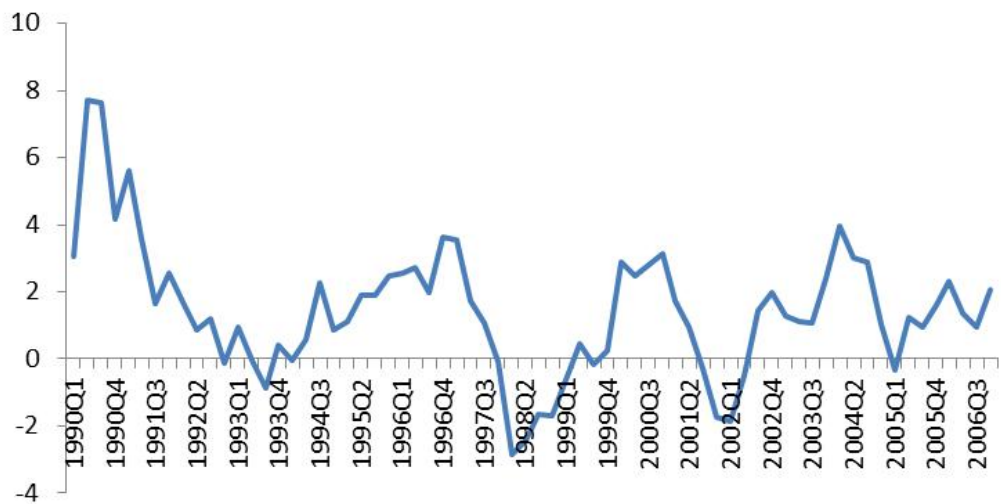
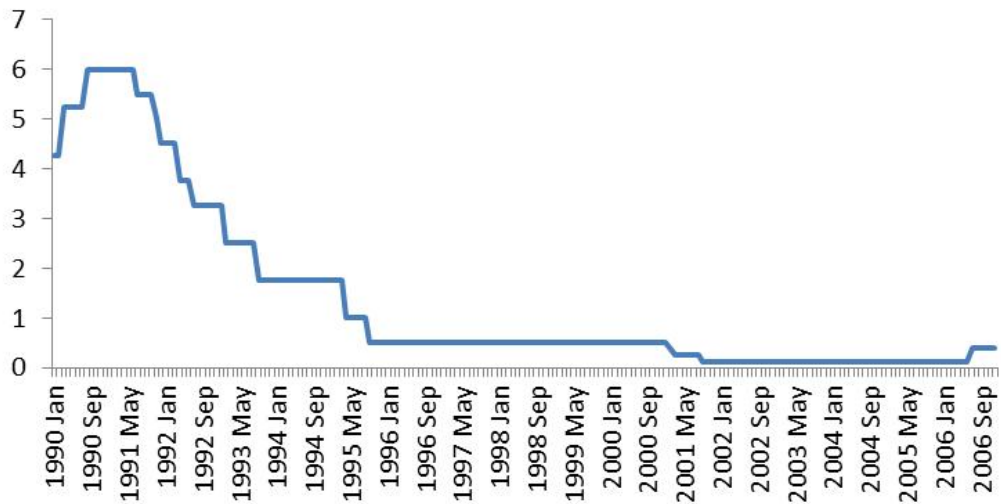
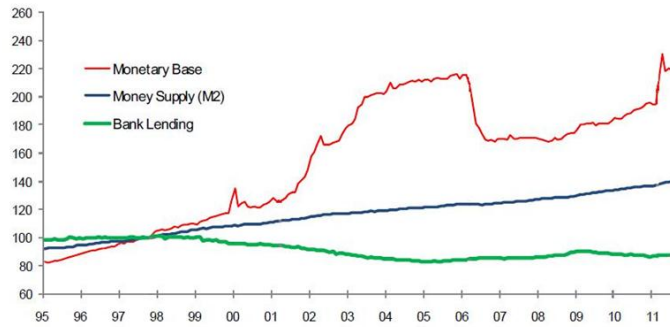
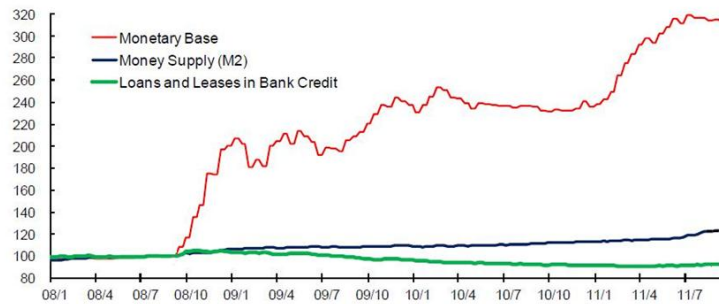


Figure 4: GDP and Interest Rate Dynamics in Japan during the First Period of Unconventional Monetary Policies Source: IMF Financial Statistics (IFS) Fig.4a-Overnight Call Rate Dynamics in Japan (1990-2006), Fig.4b-Real GDP Dynamics in Japan (1990-2006).

Liquidity Injection and Money Supply: Japan



Liquidity Injection and Money Supply: US



Liquidity Injection and Money Supply: UK

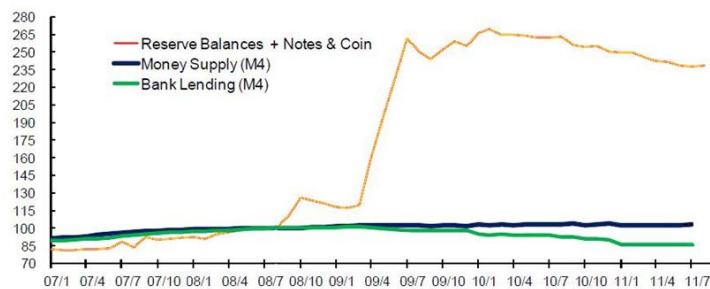


Figure 5: The Relation between Monetary Base, Money Supply and Credits in Japan, UK and US Sources: Bank of England, Bank of Japan and Federal Reserve System. Fig.5a-Liquidity Injection and Money Supply in Japan, Fig.5b-Liquidity Injection and Money Supply in US, Fig.5c-Liquidity Injection and Money Supply in UK.

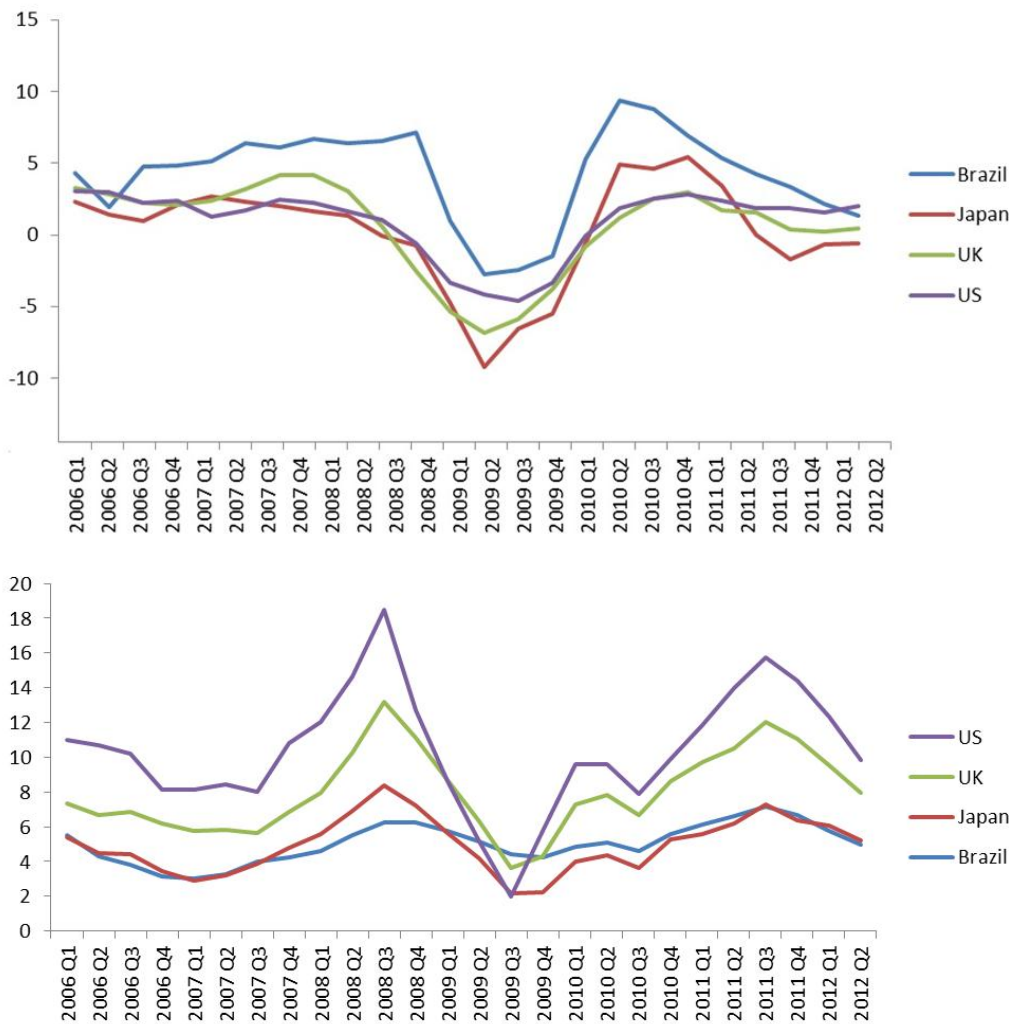


Figure 6: Percent Changes in CPI and Real GDP of US UK Japan and Brazil over Corresponding Period of Previous Year Source: IMF Financial Statistics (IFS). Fig.6a-Real GDP Dynamics in US, UK, Japan and Brazil (2006=100), Fig.6b-CPI Dynamics in US, UK, Japan and Brazil (2006=100).

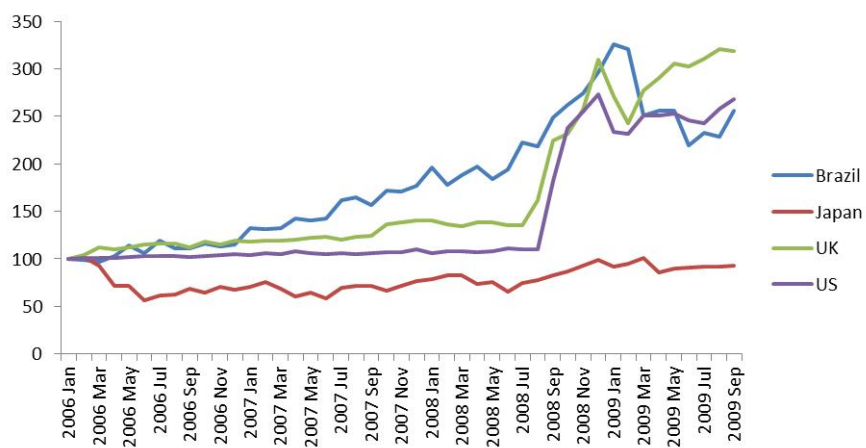


Figure 7: Developments in Central Bank Assets of Fed, BoJ, BoE after the Adoption of Unconventional Monetary Policies Sources: Bank of England, Bank of Japan, Banco Central do Brazil and Federal Reserve System.

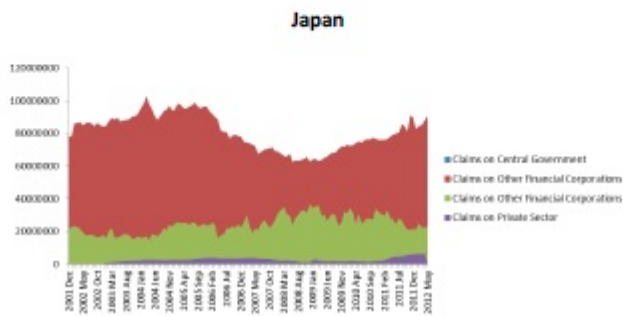
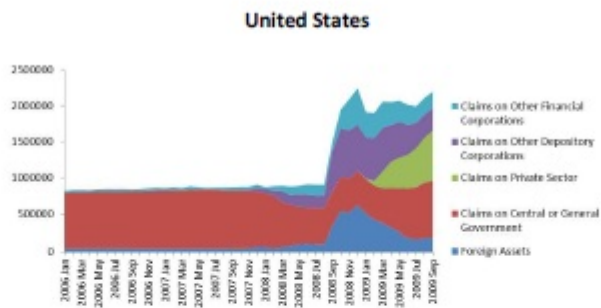
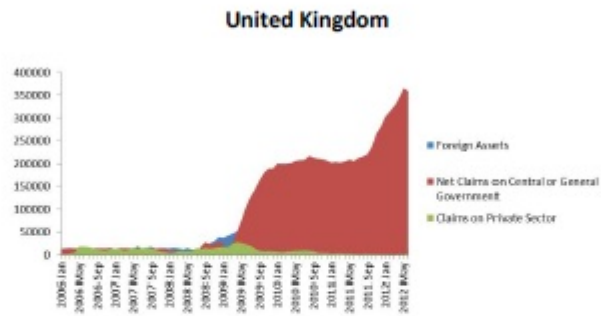


Figure 8: Differences in Balance Sheet Compositions of US and UK Source: National Banks, IMF International Financial Statistics



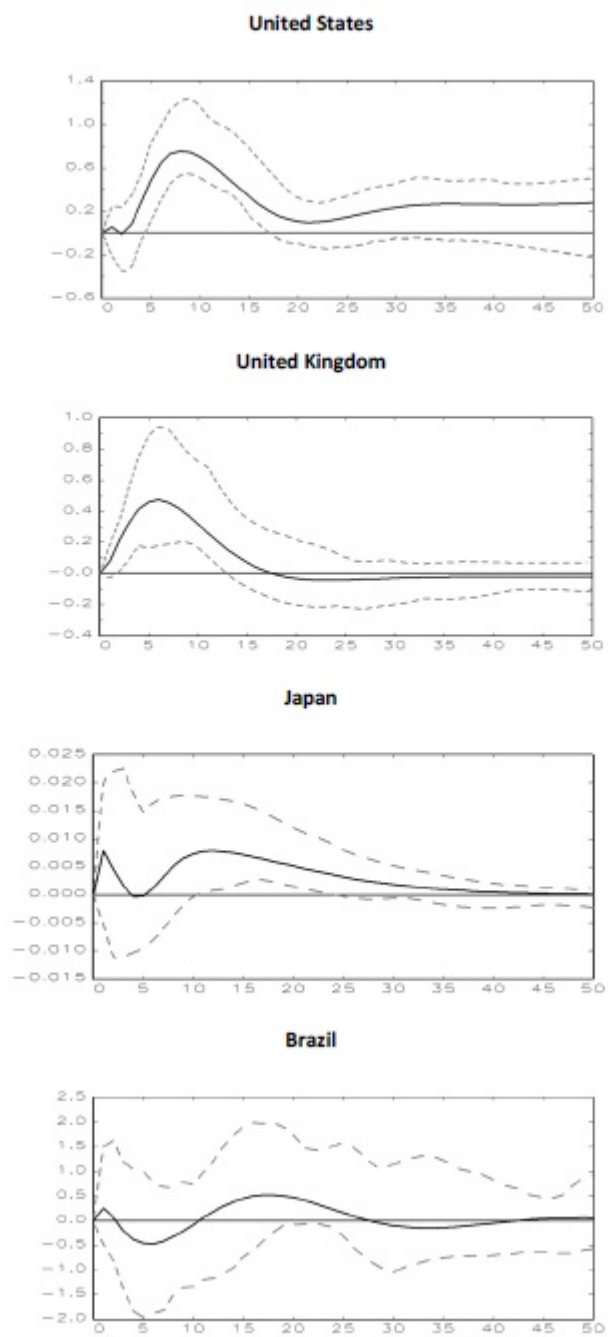


Figure 9: Impulse Responses of Economic Activity to Unconventional Monetary Policy Shock

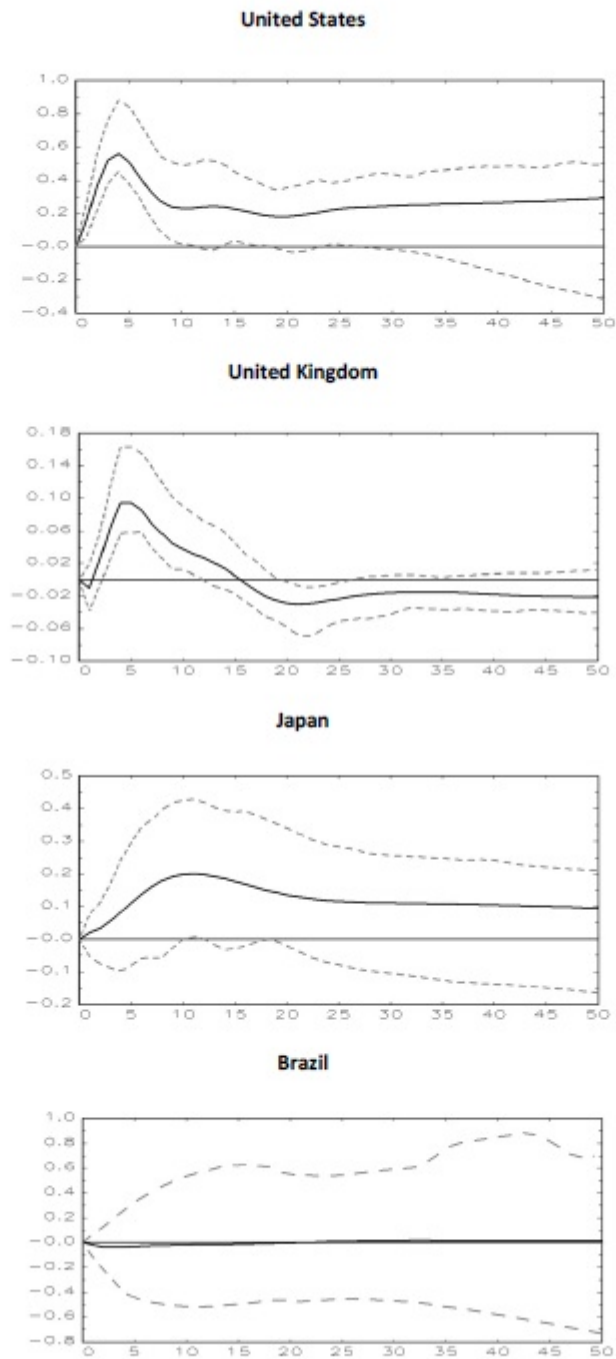


Figure 10: Impulse Responses of Prices to Unconventional Monetary Policy Shock

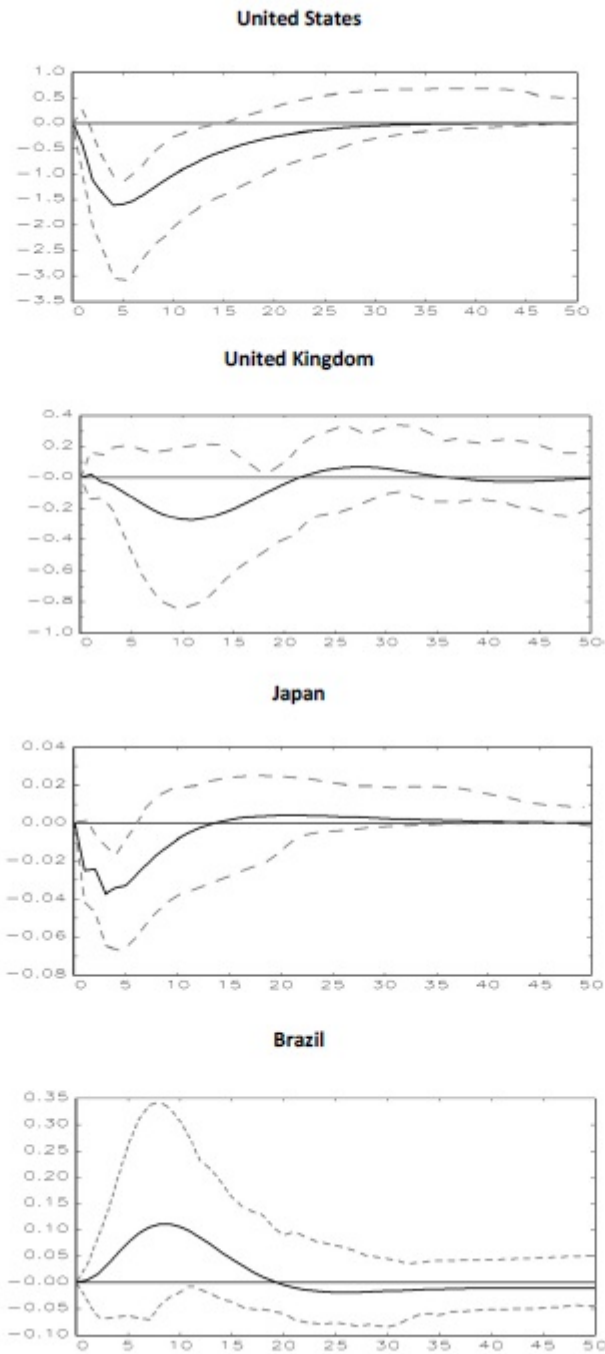


Figure 11: Impulse Responses of Interest Rate to Unconventional Monetary Policy Shock

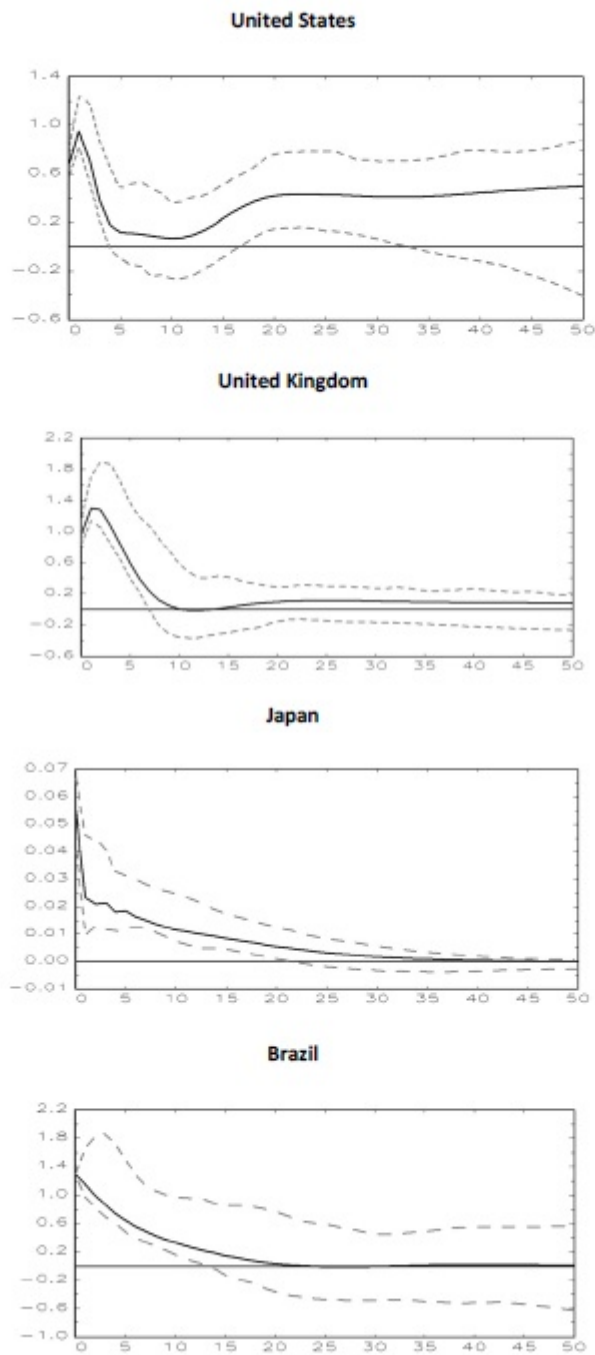


Figure 12: Impulse Responses of Monetary Base to Unconventional Monetary Policy Shock

**Balance Sheet Policies During Crisis**

Type of balance sheet policy	Measures	Fed	ECB	BoE	BoJ	BoC	RBA	SNB	BoB
Credit Policy	<i>Influence interbank market conditions</i>								
	Modification of discount window facility	✓		✓					
	Exceptional long-term operations	✓	✓	✓	✓	✓	✓	✓	
	Broadening of eligible collateral	✓	✓	✓	✓	✓	✓	✓	
	Broadening of counterparties	✓		✓	✓	✓	✓		
	Inter-central bank FX swap lines	✓	✓	✓	✓	✓	✓	✓	
	Introduction or easing of conditions for securities lending	✓		✓	✓	✓			
	<i>Influence nonbank credit market</i>								
	CP funding/purchase/collateral eligibility	✓		✓	✓	✓	✓		
	ABS funding/purchase/collateral eligibility	✓	✓	✓			✓		
	Corporate bond funding/purchase/collateral eligibility			✓	✓	✓		✓	
	Purchase of other securities	✓			✓				
Quantitative Easing	Purchase of government bond	✓		✓	✓				
	Target for bank reserves			✓					
Exchange Rate Policy	Purchase foreign currency securities							✓	✓

Table 1: Balance Sheet Policies During Crisis Source: Borio and Disyatat (2009)

Announcement date	Facility	Purpose of the Facility	Notes
12-Dec-07	Term Auction Facility (TAF)	Supply reserves to depository institutions by an auction mechanism, remove the stigma associated to discount borrowing	Last auction in March 2010
11-Mar-08	Term Securities Lending Facility (TSLF)	A weekly loan facility that provided loans of Treasury securities to primary dealers using less liquid assets as collateral. The goal was to promote liquidity in Treasury and other collateral markets and foster the functioning of financial markets more generally	Closed in February 2010
16-Mar-08	Primary Dealer Credit Facility (PDCF)	An overnight loan facility to support the liquidity of primary dealers, who traditionally cannot borrow from the Federal Reserve	Closed in February 2010
22-Sep-08	Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF)	A lending facility that financed the purchases of high-quality asset-backed commercial paper (ABCP) from money market mutual funds by U.S. depository institutions and bank holding companies. Aim was to foster liquidity in the ABCP market and money markets more generally	Closed in February 2010
07-Oct-08	Commercial Paper Funding Facility (CPFF)	Enhance liquidity situation in the commercial paper markets, provide short term financing to corporations	Closed in February 2010
21-Oct-08	Money Market Investor Funding Facility (MMIFF)	Provide liquidity to U.S. money market mutual funds and certain other money market investors, thereby increasing their ability to meet redemption requests and increase their willingness to invest in money market instruments, in particular commercial paper	Expired in October 2009
25-Nov-08	Term Asset-Backed Securities Loan Facility (TALF)	A funding facility that issues loans with a term of up to five years to holders of eligible asset-backed securities (ABS). The TALF is intended to assist the financial markets in accommodating the credit needs of consumers and businesses of all sizes by facilitating the issuance of ABS collateralized by a variety of consumer and business loans;	Planned to be closed in June 2010
1-Jul-09	Term Securities Lending Options Program (TOL)	Enhance the effectiveness of the TSLF by offering additional liquidity during periods of heightened collateral market pressures	Closed in February 2010

Table 2: Facilities that the Fed established during the financial crisis Source: The Federal Reserve, Cecchetti (2009)