

Balance Sheet Policies: A Primer

by

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Abstract

Balance sheet policies have become the primary policy lever of several central banks in the wake of the international financial crisis. However, with inflated central bank balance sheets, and global economic conditions returning to normal, the future of balance sheet policies needs to be considered. In this paper I aim to define a role for balance sheet policies in the monetary policy toolkit, especially with regard to financial stability. This review contributes to the existing literature by developing an explicit definition of balance sheet policies and their channels of transmission to help resolve the confusion clearly visible in the academic literature and popular media.

Part I

Balance Sheet Policies I: Early History and Theory

The central bank's balance sheet has 'always' been a policy tool, especially in open economies where central banks hold foreign reserves. . . The use of QE and other unconventional tools in the recent past has just made us study these issues better, learn more about their effects, and so become more confident about using them in the present and in the future.

— Ricardo Reis in the CFM Survey (2016)

Central banks across the globe have resorted to unconventional monetary policy (UMP), in light of the fact that conventional expansionary interest rate policy alternatives have been exhausted. However, balance sheet policies are not considered all that unconventional. In particular, as illustrated in this section, it is the choice of asset markets targeted by central bank purchases that makes a balance sheet policy unconventional (Borio and Disyatat, 2010). In the US, for example, the Federal Reserve Act allows the central bank to buy and sell assets “without regard to maturities but only in open markets” (D’Amico et al., 2012). This implies that the Fed could undergo purchases of long-term government debt without contravening this act, while still staying within the realm of what is considered conventional. However, large-scale asset purchases of private sector securities extend the balance sheet of the bank beyond its ‘Treasury only’ protocol¹, moving it into unconventional territory (Woodford, 2012). Even before the current crisis, there were examples where the usage of central bank balance sheets were considered normal.

1 Early Balance Sheet Policy (Post-War Period)

In the broadest, sense balance sheet policies can be viewed as any balance sheet action taken by the central bank that attempts to affect asset market conditions beyond adjusting a short-term

¹The central bank is only supposed to carry Treasuries on the asset side of the balance sheet. However, Treasuries can be of different maturities.

interest rate (Borio and Disyatat, 2010). Derivatives of modern balance sheet policy were first implemented in foreign exchange intervention, long before the current financial crisis². The management of exchange rates is not of specific interest to the balance sheet narrative explored in this thesis. Nevertheless, foreign exchange intervention is referenced to demonstrate that the use of balance sheets by central banks, beyond that of interest rate management, preceded the response to the international financial crisis.

These operations of central banks in the post-War period were primarily performed by developing countries in an attempt to exert pressure in an ever-changing exchange rate environment. They can be defined as central bank intervention in the foreign exchange market, the buying/selling of foreign currency to affect the exposure of private agents. Exchange rate policy is especially prominent in emerging Asia, with South Korea, Thailand and China identified as examples of countries that have managed to intervene in foreign exchange markets through sterilised purchases³ of foreign assets (Borio and Disyatat, 2010). More recently, reserve accumulation (expansion of the central bank's balance sheet) has been a characteristic of developing countries in the aftermath of the 1997-8 Asian financial crisis, in attempts to resist the appreciation of their domestic currencies (Filardo and Grenville, 2012). With that considered, the next section introduces the first part of our discussion on modern central bank balance sheet policy, which was spearheaded by Japan in a concerted effort to avoid deflation.

2 The Zero Lower Bound (1990s)

2.1 The Lost Decade and the Liquidity Trap

Balance sheet measures were thrust into the spotlight during the 1990s, owing to the derailment of the Japanese economy following a period of rapidly increasing prosperity. Japan's 'lost decade' refers to the prolonged economic slump experienced since the early 1990s. A dissection of the slowdown identified several causal factors: a protracted period of overly accommodative monetary policy; a banking crisis (on the back of non-performing loans); and an asset-price bubble collapse (Ito and Mishkin, 2006)⁴. During this decade, specifically in the period between 1992 and 2002, the Japanese real economy grew at a meagre rate, slightly above 1% on

²*Exchange rate policy* is one of the least mentioned balance sheet policies (Borio and Disyatat, 2010).

³The central bank might intervene in the foreign exchange market by purchasing local currency, through the sale of foreign exchange reserves; that, in this case, cause an appreciation. However, this reduces money supply, which could be deflationary. In order to sterilise these purchases, the central bank can conduct open market operations to increase the money supply.

⁴For a good review of the events that led to this downturn, see the article by Ito and Mishkin (2006).

average (Ueda, 2005)⁵. In 1995, in response to anaemic growth and budding deflation, the Bank of Japan (BoJ) brought interest rates close to the zero lower bound (ZLB)⁶. Despite the expansionary efforts of the monetary authority, three large Japanese banks⁷ failed due to sustained capital losses and, in concert with the Asian financial crisis of 1998, this heralded the start of deflation⁸ (Ito and Mishkin, 2006). This called for a reduction of the interest rate to the ZLB and ignited fears that a “liquidity trap” might emerge (Okina and Shiratsuka, 2004).

As first mentioned by Keynes (1936) and later formalised by Hicks (1937), once the nominal policy rate reaches a level close to zero, the central bank might find itself in a liquidity trap; this is defined as a low interest rate environment in which liquidity injections are rendered ineffective because money and bonds have become perfect substitutes. Traditional Keynesian thinking on monetary policy⁹ accepts that, once in a liquidity trap, the central bank becomes impotent with respect to its ability to stimulate economic activity¹⁰ (Hicks, 1937).

Japanese central bankers grappled with the potential loss of their primary policy lever and the possibility of chronic deflation. However, as argued by Krugman (1998) at the time, the conclusion that central banks are powerless at the ZLB is far from categorical. He proved, using an IS-LM framework, that a sustained increase in “outside money”¹¹ at the ZLB can have an inflationary impact on the economy, increasing both the general price level and output (Krugman, 1998). In order for this increase to be effective, the central bank is required to commit to future increases in the monetary base (Krugman, 2000). In other words, public expectation needs to be guided by the actions of the central bank, in order for the expansionary policy to work when interest rates have hit the ZLB (Bernanke, 1999).

⁵It should be noted that during this period, population growth was declining, which translates into a better overall picture of growth in per capita terms (Economist, 2008).

⁶The term zero lower bound has become a bit of a misnomer with recent developments of negative nominal interest being implemented in several central banks (Feroli et al., 2016). However, I have kept the term as it reflects the discussion at the time. In addition, it should be noted that in several instances during the discussion of the financial crisis that I refer to ZLB, but it could be that the interest rate is 10-30 basis points above this. In a practical sense, this is considered an effective ZLB by the market participants (Gerlach and Lewis, 2010).

⁷These banks were Hokkaido Takushoku, Long-term Credit, and Nippon Credit.

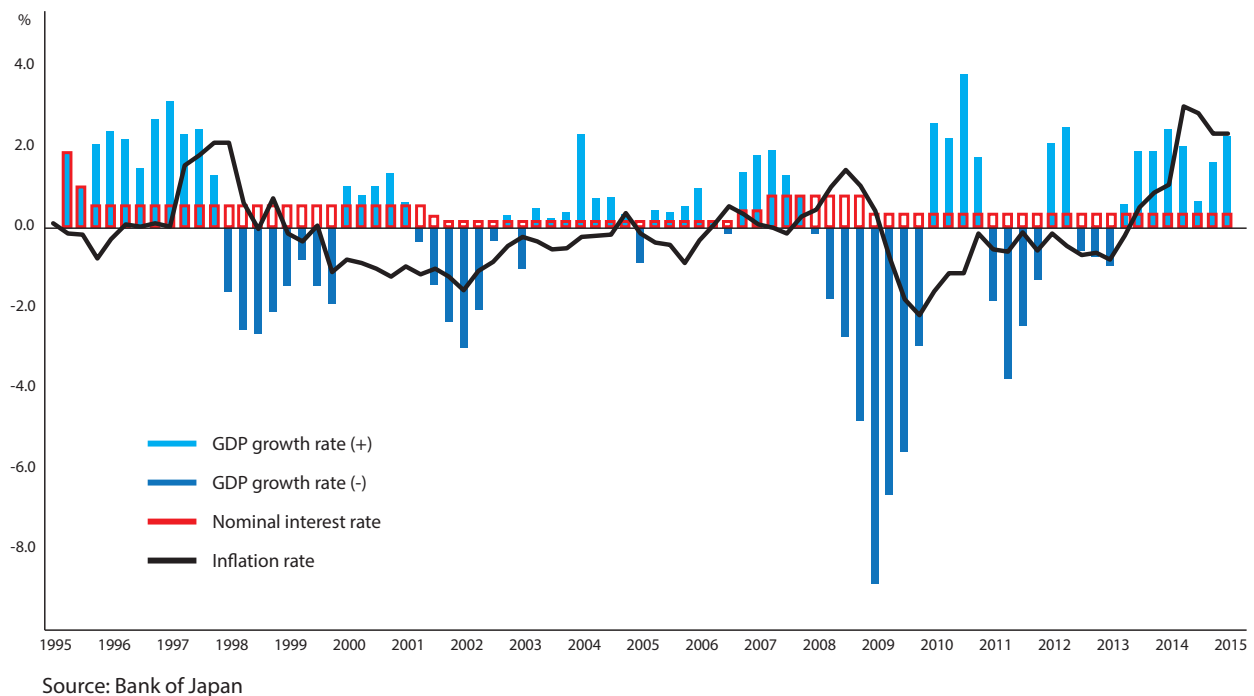
⁸In other words, this is a negative rate of inflation. Usually, this is considered a troubling economic position, as agents in the economy defer consumption and investment, causing economic growth to stall indefinitely.

⁹This type of thinking emphasises the belief that the only instrument available to the central bank is its control over the short-term policy rate, usually described with the use of an IS-LM type of model.

¹⁰This is thought of as the Keynesian challenge of monetary policy, whereby the claim is that monetary policy is ineffective at combating recessions (“pushing on a string”).

¹¹Outside money is money without corresponding liability.

Figure 1: Japanese growth, inflation and interest rates



3 ZIRP and QEP in Japan (1999 - 2006)

3.1 Zero Interest Rate Policy (1999 - 2000)

The BoJ implemented several nonstandard monetary policy measures in an attempt to spur economic growth and avoid deflation, in line with the policy recommendations made by Krugman (1998). In 1999, in the wake of the currency crises experienced by many South-East Asian economies, the BoJ adopted a zero interest rate policy (ZIRP), with a commitment to keeping the uncollateralised call rate at a level of zero “until deflationary concerns are dispelled”¹². Implementing such a policy is supposed to shape public interest rate expectations, indicating the ‘easy’ stance of monetary policy. Achieving success with this measure requires transparency and continued communication on the side of the central bank (Woodford, 2012).

In 2000, the BoJ believed the Japanese economy to be in recovery, with forecasts of the consumer price index (CPI) indicating the possibility of at least zero percent inflation (Momma and Kobayakawa, 2014). Despite protestation from academics and private sector economists, the central bank reneged on their zero rate commitment at the first signs of growth, and increased

¹²As stated by Governor Hayami at a press conference on April 13, 1999. This is known as a conditional (state-dependent) commitment, and is one of the first examples of forward guidance - albeit rather weak in its implementation

the call rate by 25 basis points (Ito and Mishkin, 2006). However, economic conditions rapidly worsened in 2001 with the burst of the global ICT bubble¹³, and the BoJ reversed their rate increase with the declaration that ZIRP would continue until the “inflation rate becomes stably above zero” (Ito and Mishkin, 2006). Reneging on the zero rate commitment severely damaged the credibility of the bank for several years afterwards¹⁴. The next section considers the repercussions of the BoJ’s decision and the eventual usage of QE in an attempt to change public perception of their resolve to combat deflation.

3.2 The Quantitative Easing Program (2001 - 2006)

Having blemished their reputation, the BoJ adopted a quantitative easing program (QEP) in March 2001 to complement their renewed ZIRP, trying to bolster their expansionary commitment. Quantitative easing (QE) as utilised by the BoJ primarily entailed providing reserves in excess of those needed to keep the interest rate at the ZLB. This approach to monetary easing was supported by several academics, such as Krugman (1998), Meltzer (1998) and McKinnon and Ohno (1997). However, there were dissidents who believed that this type of policy would have fiscal implications, with the central bank exposed to unwanted investment risk in potentially volatile asset markets (Fujiki et al., 2001). This issue is becoming increasingly important as central banks across the world extend their balance sheets to include a wider range of securities. It also raises the issue of central bank independence, which is discussed at the end of the section. In addition, there are concerns that the balance sheet expansion will be ineffective and ultimately lead to high levels of inflation.

A simple definition of quantitative easing is an increase in the size of the central bank’s balance sheet. In the case of Japan, this translated into switching of the policy instrument from the short-term interest rate to the current account balance (CAB)¹⁵ (Ito and Mishkin, 2006). The BoJ framed its approach as a three-pronged attack. First, it set a target for current account balances in a stepwise fashion, starting with ¥5 trillion¹⁶ in 2001 and steadily increasing this over four years to between ¥30 and ¥35 trillion (Momma and Kobayakawa, 2014). This amounts to increasing base money in the economy with the target of supplying the economy with a surplus of liquidity.

¹³Refers to a speculative bubble that formed as the result of a sudden increase in equity values of Internet-based companies. It is also known as the dotcom bubble.

¹⁴The paper by Ito and Mishkin (2006) discusses the market behaviour during this period, which points to the loss of confidence in the central bank’s ability to conduct policy.

¹⁵This refers to the commercial bank balances held at the central bank and should not be confused with the current account on the balance of payments.

¹⁶Which is in excess of the required balances of ¥4 trillion, providing the name ‘excess reserve targeting’.

Second, as a corollary to the first arm, the central bank committed to providing liquidity in excess of the banks' reserve requirement, to keep expectations on the short-term interest rate fixed at zero. Under this commitment the BoJ also made clear the conditions under which ZIRP would be lifted (Momma and Kobayakawa, 2014). The specific condition in this case was achieving a positive inflation rate and maintaining it for a prolonged period. Third, the purchase of long-term Japanese government bonds (JGBs) was conducted gradually; monthly outright acquisitions started at ¥400 billion in August 2001, and eventually reached a level of ¥1200 billion in October 2002 (Ito and Mishkin, 2006). This third prong still operated under the guise of quantitative easing, as the asset purchases were not sterilised¹⁷ by concomitant sales of short-term debt, a topic that is covered in more detail in the section on balance sheet typologies.

In addition to quantitative easing, from 2003 to 2006 the BoJ temporarily implemented credit easing through intervention in asset markets; this entailed changing the composition (asset side) of the central bank's balance sheet by buying asset-backed securities (ABS). The BoJ made it clear that this intervention was done in the spirit of financial market stabilisation and should not be considered under the banner of monetary policy. In general, the reason the BoJ implemented credit easing was to depress long-term interest rates and thereby encourage interest-sensitive economic activity¹⁸. In 2006 the BoJ, believing that inflation was sufficiently entrenched, announced its plan to terminate unconventional policy arrangements (Shiratsuka, 2010). A successful exit from QE relied on clear communication of the policy stance of the BoJ. In this period, the intentions of the BoJ were made clear to stakeholders, with the specific goal of preparing financial institutions for the withdrawal of liquidity.

3.3 Shaping Market Expectations: Hayami vs Fukui

At this point it is necessary to make a distinction between policy conducted under Governors Hayami (1998 - 2003) and Fukui (2003 - 2008). Before 1998, at the start of Hayami's term, policymakers had little practical experience in dealing with a liquidity trap (apart from the Great Depression). During that period, the first round of quantitative easing was implemented and appeared largely to be ineffective. The problem was the policymakers' failure to signal the nature of their policy commitment and in so doing to disarm deflation (Ito and Mishkin,

¹⁷Sterilised in the context of balance sheet policy usually refers to actions by the central bank that counteract a cash injection resulting from asset purchases (Woodford, 2012). In the case of Operation Twist, for example, an increase in long-term Treasuries was met with a decrease in short-duration debt; which is a 'cash-neutral' operation. Alternative strategies implemented by central banks to sterilise purchases are the use of term deposit facilities and reverse repurchase agreements (Ihrig and Meade, 2015).

¹⁸This mechanism is discussed in more detail in the next section.

2006). It has been argued that this was because QE was conveyed as a temporary measure, without proper support from a tentative administration. The credibility of the bank was harmed under Governor Hayami, as market participants were not always certain of the direction policy would take. Indeed, as pointed out by Ito and Mishkin (2006), Hayami constantly changed his position without providing the proposed mechanism of operation.

In 2003, when Governor Fukui was appointed, he immediately changed the message portrayed by the central bank, by ratcheting up quantitative easing measures to reinforce the claims of an expansionary policy commitment (Ito and Mishkin, 2006). Communication strategies were significantly more transparent under the leadership of Fukui. The necessary conditions for an exit from the ZIRP were explicitly stated. The change in rhetoric was found immediately to have an impact on the recovery of the financial sector, with a more protracted rebound of real variables (Ito and Mishkin, 2006). Forward guidance under Fukui was more successful because announcements left little room for interpretation as to the position of the bank, with the commitment of the bank being linked to actual and not forecasted values of CPI (Momma and Kobayakawa, 2014).

Empirical evidence suggests that QE under Fukui was effective in establishing market expectations on future short-term interest rates, and ultimately on the long-term rates (Ugai, 2007). The most profound impact of the change in rhetoric was on the financial markets and the state of the banking sector, with the real economy showing only slow signs of recovery, which suggested that the blockage in transmission was between nonfinancial and financial sectors (Ito and Mishkin, 2006). Up until this point, it was not necessary to be specific about balance sheet policies, as the types implemented in Japan before the financial crisis were sufficiently simple, fitting easily into broad classifications. However, as we delve deeper into what balance sheet policies encompass, it might be useful to have an appropriate typology toolkit.

4 Making Sense of Balance Sheet Typologies

The Japanese experiment generated a discussion on the role of monetary policy in a deflationary environment. In what follows, I discuss some of the most important theoretical contributions on the topic. These contributions were used to answer questions posed during the financial crisis in 2008. The implications of central banks being constrained by the ZLB is highlighted in the academic works of authors such as Reifschneider and Williams (2000), Blinder (2000), Clouse et al. (2003), Svensson (2003), Orphanides and Wieland (2000), Eggerston and Woodford (2003) and the seminal article by Bernanke et al. (2004). In general, there are several

instruments available to the central bank once the interest rate reaches the ZLB, most of which were implemented in the case of Japan, with varying degrees of success.

In the literature there are several classifications of balance sheet policy tools beyond interest rate policy. Bernanke et al. (2004) first identified three plausible policy tools to use once the ZLB is reached: (i) the management of public expectations on the course of interest rates, through communication strategies; (ii) changes in the size of the central bank balance sheet; and (iii) changes in the composition of the central bank balance sheet.

Woodford (2012) aggregates these tools into two streams, namely forward guidance and balance sheet policies. I am primarily interested in the latter, which entails changes in the size (quantitative easing) and composition (credit easing) of the central bank balance sheet. A more detailed taxonomy proposed on these balance sheet policies is that of Borio and Disyatat (2010), which is discussed in Section 4.2.1.

4.1 Expectations/Forward Guidance

Among the first authors in the modern literature to consider seriously the consequences of a deflationary trap, is Krugman (1998, 2000). He contends that the appropriate solution to a deflationary environment is to manage expectations, something that was poorly implemented in the early years of the Japanese deflation. Several authors in the literature, such as Eggerston and Woodford (2003), Svensson (2003), and Auerbach and Obstfeld (2005) agree that this is the best strategy to employ in order to escape a liquidity trap. Central banks in this predicament need to convince markets that they will commit to a higher rate of inflation in the future, allowing expectations to form around the objective of persistently easy monetary policy. Krugman (1998) suggests that the central bank set a high inflation target¹⁹ over the medium term in order to stabilise expectations.

Krugman's suggestion was met with resistance, as a high inflation target is at odds with the idea of price stability. The work by Eggerston and Woodford (2003) points out that once the economy emerges from the deflationary environment, a time-inconsistency problem would emerge. Given the central bank mandate to maintain price stability, the policymaker would be admonished for aiming for a high inflation target; Krugman (1998) refers to this as committing to "being irresponsible". In other words, owing to time-inconsistency, the public would expect the central bank to renege on its high inflation rate commitment and the economy would fail to move from its deflationary environment.

¹⁹Krugman (1998) suggests a medium-run target of 4% for fifteen years

The Japanese experiment can be understood as an example of such time-inconsistency. When faced with a slightly positive inflation rate, the central bank increased the call rate above the ZLB, claiming that financial markets had stabilised. This action severely damaged the credibility of the monetary authority, and when the economy moved back into a deflationary environment, the newly appointed Governor had to look to unconventional policy in conjunction with a policy rate commitment to boost economic growth and avoid deflation. The Japanese example shows that sometimes announcing the target is not enough to pin down expectations. In order to increase the credibility of its commitment, the central bank might have to combine elements of balance sheet policy with an inflation target, which is referred to in the more modern literature as forward guidance (Woodford, 2012).

4.2 Changes in Size and Composition

Central banks were created with the unique ability to issue bank reserves, making them the monopoly supplier of bank money in the economy (Goodhart, 1988). These liabilities of the central bank can be generated freely, without cost or limit. It is important to remember that, as Lord Cobbold reputedly said, the “Central Bank is a bank, not a study group” (Goodhart, 2011, p. 146). Central banks are responsible for the provision of liquidity to the banking system, which acts as liquidity insurance that filters through to households and firms via commercial banks (Tucker, 2014). In this regard, post-war monetary policy was initially concerned with the management of the central bank’s balance sheet (Friedman, 1964). In recent years, the focus has shifted to guidance of the nominal short-term policy rate. However, as argued by du Plessis (2012), “determining the level of a policy interest rate is not a necessary function of the central bank”. The international financial crisis has refocused the attention of central bankers of balance sheet policies as part of the monetary policy toolkit.

There are several typologies of balance sheet policy, depending on the source being consulted. In the most general sense, balance sheet policies operate along the dimensions of size and composition. Increases in the size of the balance sheet usually mean “open market operations on short-term government debt, outright purchase of long-term bonds (or equities), or through unsterilized purchases of foreign currency” (Ito and Mishkin, 2006). However, quantitative easing has become synonymous with the expansion of the central bank balance sheet (particularly the monetary base) without changing the composition of assets. Quantitative easing in this sense entails the purchasing of assets by the central bank, leaving the type of assets on their portfolio unchanged, while increasing reserve liabilities on the other side of the balance sheet (Lenza et al., 2012). Some authors, such as Woodford (2012), refer to this as ‘pure’ quantitative

easing, while Reis (2009) calls it quantitative policy. Cúrdia and Woodford (2011) refer to this as reserve-supply policy, which is the choice of reserves in the system. In essence, these are open market operations where central bank liabilities (reserves) are traded in return for Treasury securities.

Credit/qualitative easing is generally perceived as balance sheet management aimed at altering the composition of the central bank's balance sheet (Cúrdia and Woodford, 2011). In this setting, the size of the balance sheet remains the same but the underlying portfolio of assets changes from conventional assets held to include a variety of 'unconventional' assets, ranging from long-term government debt to private sector securities (Lenza et al., 2012). One central banker, that was adamant about the distinction between quantitative and credit easing, is Bernanke (2009). He argues that,

The Federal Reserve's approach to supporting credit markets is conceptually distinct from quantitative easing (QE), the policy approach used by the Bank of Japan from 2001 to 2006. Our approach - which could be described as 'credit easing' (CE) - resembles quantitative easing in one respect: It involves an expansion of the central bank's balance sheet. However, in a pure QE regime, the focus of policy is the quantity of bank reserves, which are liabilities of the central bank; the composition of loans and securities on the asset side of the central bank's balance sheet is incidental.

This typology is quite broad and is sometimes an inaccurate representation of policy intent; in other words, it does not always encapsulate the nuance of specific policy actions. My discussion of the balance sheet policies used during the financial crisis requires a more precise classification. As we will see, changes in the composition of the balance sheet of the central bank often accompany increases in size, if purchases are unsterilised. It becomes increasingly difficult to map the textbook view of changes in size and composition onto policy actions taken during the financial crisis (Lenza et al., 2012).

4.2.1 A More Precise Typology

A more granular classification is probably better suited to the identification of different balance sheet policies. I use the typology of Borio and Disyatat (2010) who have a four-fold classification that includes exchange rate policy, quasi-debt management policy, credit policy and bank reserves policy. This typology is summarised by Figure 2.

First, *exchange rate policy*, which is briefly described in the first part of this section, is not considered further. Second, *quasi-debt management policy* entails central bank intervention in

Figure 2: Typology of balance sheet policies

		Impact on private sector balance sheets		
		Change in net FX exposure	Change in the composition of claims on the public sector	Change in profile of claims on private sector and /or composition of claims on public vs private sector
Market targeted	Foreign exchange	★		
	Public debt		□	
	Private credit			⊛
	Bank reserves			
Exchange rate policy (★); Quasi-debt management policy (□); Credit policy (⊛) Bank reserves policy (shaded area)				

Source: Borio and Disyatat (2010)

the market for public sector debt. Policy in this sphere operates mainly on the composition of private sector balance sheets, with the aim of altering the composition of government securities held in the hands of private agents. In general, the aim is to alter the yield curve on Treasury securities. Policy in this vein could translate into interest rate risk for the central bank as it take on riskier long-term government debt.

Third, *credit policy* refers to targeted purchases of private assets in specific markets in order to affect private sector balance sheets. During the financial crisis, this type of policy was employed to “enhance market liquidity, reduce risk spreads, promote new issuance, and increase private access to credit” (Meier, 2009). Credit policy often exposes the central bank to credit risk on private sector claims, an issue that is covered in more depth in the discussion on the measures used in the financial crisis. Finally, *bank reserves policy* requires increasing liabilities, by setting a specific target for bank reserves, independently from what happens on the asset side of the central bank balance sheet.

Quantitative easing, for example, in the case of Japan (2001 - 2006), in this taxonomy is seen as a combination of bank reserves policy and forward guidance (Borio and Disyatat, 2010). There are also elements of quasi-debt management policy, with the purchase of long-term Japanese government bonds, in the latter part of the QE program.

Defining QE as merely an increase in the size of the balance sheet loses some of the nuance involved; however, such simplifications will sometimes be made to facilitate model construction. It is important to understand not only the general classification, but also the channels of policy transmission, in order to comprehend why policy actions are performed. In the following section I discuss some of the most important transmission channels for balance sheet policies.

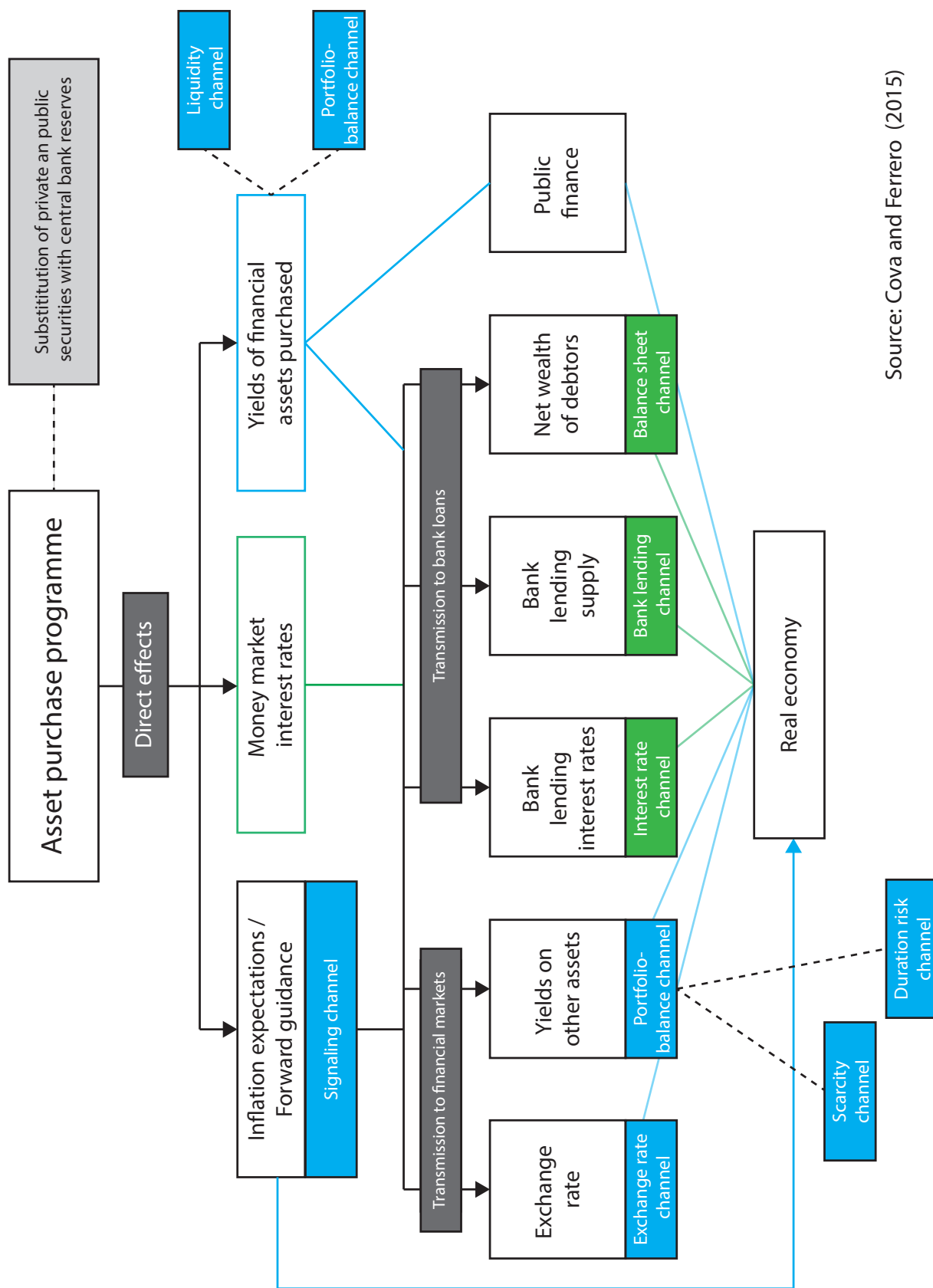
5 Transmission Channels

Up to this point, I have abstained from discussing the transmission mechanism, but the balance sheet policies used by the central bank during the crisis rely on an understanding of transmission channels (Krishnamurthy and Vissing-Jorgensen, 2011). In this section I discuss, in greater detail, the transmission channels through which balance sheet policies - specifically quasi-debt management and credit policies - are thought to affect financial markets and a broader range of macroeconomic indicators. In particular, they are thought to have three direct effects, through: (i) asset yields/prices; (ii) money market rates; and (iii) market confidence/expectations, as depicted in Figure 3 (Cova and Ferrero, 2015).

There are diverging theories on the channels through which balance sheet policies are transmitted to the broader economy. However, there is some consensus that there are two primary channels: the signalling channel and the portfolio balance channel, with several plausible subchannels (Bernanke et al., 2004; Borio and Disyatat, 2010). It should be noted that this classification is not exhaustive and includes primarily the main channels of transmission as well as some relevant subchannels. Only the relevant channels are discussed here, as there are several taxonomies in the literature, with differing levels of complexity. Figure 3, which is adapted from Cova and Ferrero (2015), is provided to give a summary of potential transmission channels and effects.

5.1 Portfolio Balance Channel

The most natural setting for balance sheet policies when the interest rate has reached the ZLB is the portfolio balance channel. Several policymakers such as Bernanke (2009), Yellen (2011), and Bean (2011) specifically mention this channel in conducting large-scale asset purchases during the recent crisis. The portfolio balance effect refers to the ability of the central bank to affect term, risk, and liquidity premiums (i.e. overall yields) through open market operations (Bernanke et al., 2004). More simply stated, it describes “how the purchase of a given asset



Source: Cova and Ferrero (2015)

Figure 3: Transmission channels of balance sheet policies

pushes up the price of that asset and its substitutes” (Krishnamurthy et al., 2014). A large part of modern research on balance sheet policies focuses on this channel, with a rich vein of literature dating back to the late 1950s. It is important to mention that the portfolio balance channel (PBC) itself is multidimensional, with a further subdivision normally entailing a discussion on the scarcity and duration risk channels (D’Amico et al., 2012). These mechanisms are individually explored.

5.1.1 History of the Portfolio Balance Channel

The literature on the portfolio balance channel originates largely from the discussion surrounding the Fed’s ‘bills only’ policy, which it adopted in 1953. Within the confines of the Federal Reserve Accord, the central bank could conduct open market operations only through the trading of short-term Treasury securities (D’Amico et al., 2012). The logic, as presented in Riefler (1958), was that the central bank could steer expectations on the long-term interest rates through its control over the path of the short-term rate. This meant that movements in the short-term rate would transmit through the interest rate structure, by its influence on market expectations, to steer the long-term rate, all without intervention in long-term markets. This is referred to as the expectations hypothesis of the term structure of interest rates, which is normally depicted using a yield curve²⁰ (Thornton and Guidolin, 2008).

Criticism on the exploitable link between short- and long-term asset markets emerged in the academic literature, with an early critique of the bills-only approach provided in the work of Culbertson (1957), Conard (1959), and Ascheim (1961). The Kennedy administration was supportive of this assessment of the bills-only policy and ratified Operation Twist in 1961 in order to affect the term structure of interest rates, which entailed increasing the amount of long-term securities on the balance sheet of the central bank. In principal, this policy to change the composition of the central bank balance sheet was aimed at decreasing the long-term rate by increasing the supply of long-term bonds relative to short-term bonds (D’Amico et al., 2012). Control over the long-term rate was considered important, as aggregate demand is influenced by more than just the short-term interest rate, which is pointed out by both Keynesians (Tobin, 1969) and monetarists (Brunner and Meltzer, 1973; Friedman and Schwartz, 1982)²¹. This approach is juxtaposed by the current quasi-debt management strategy followed by central banks to depress long-term Treasury rates²².

²⁰A yield curve reflects the relationship between bonds with similar ratings but different maturities (Strohsal, 2013). It is usually upward sloping, as longer maturity bonds are supposed to have a higher yield.

²¹The idea that several asset yields should be taken into consideration is at the heart of the monetarist transmission mechanism.

²²It is easy to observe the heritage of the newly implemented LSAPs in the US, with the maturity extension program accompanying QE2 also referred to as Operation Twist.

5.1.2 Preferred Habitat / Scarcity Channel

Although Operation Twist was initially judged to be largely ineffective²³, it acted as a catalyst for the further development of a theoretical literature on the term structure of interest rates. In particular, it inspired Culbertson (1957) and Modigliani and Sutch (1966) to establish the “preferred habitat” approach. This is a market segmentation theory that points to the fact that investor clienteles might have a preference for assets of a specific maturity, and that the “interest rate for a given maturity is influenced by demand and supply shocks local to that maturity” (Vayanos and Vila, 2009). Notably, this establishes a positive correlation between asset yields and the relative supply of long-term securities²⁴ (Strohsal, 2013).

It is generally accepted that generating portfolio balance effects relies on imperfect asset substitutability²⁵. As stated by Bernanke and Reinhart (2004), “if the liquidity or risk characteristics of securities differ, so that investors do not treat all securities as perfect substitutes, then changes in relative demands by a large purchaser have the potential to alter relative security prices”. Under the assumption that assets are imperfect substitutes, Tobin (1961, 1969) was among the first to illustrate that a large buyer, such as the central bank, could alter the supply of assets - with different maturities or liquidity - and thereby plausibly influence asset yield patterns. In this narrative the purchase of securities by the central bank will increase the amount of one asset relative to others in the private sector portfolio. In response to these open market operations, the public will rebalance their portfolio to include more of the scarce (often riskier) assets, which raises their price and lowers their yield; this is often referred to as the scarcity / local supply channel (Bernanke et al., 2004).

Initial discussions on imperfect asset substitutability and the related portfolio balance effects centred on the ability of the central bank to affect long-term asset yields through the scarcity channel. This mechanism relies on the fact that there are limits to quantities of a certain asset that investors can buy (Dai et al., 2013). In fact, as mentioned, this was the idea behind Operation Twist in the 1960s, which entailed a change in composition of the balance sheet in order to affect term structures. Quasi-debt management and credit policy²⁶ relies on imperfect asset substitutability in order to work; with securities of different maturities and risk profiles treated as imperfect substitutes (Borio and Disyatat, 2010). Theoretically, there are several

²³Initial studies showed an insignificant affect on long-term rates. However, a recent article by Swanson (2011) shows that an event-study approach reveals a significant reduction in long-duration security yields.

²⁴There are some caveats, with the magnitude of the correlation dependent on the risk aversion of arbitrageurs.

²⁵Some of the most prominent early contributions in the work on imperfect asset substitutability can be found in the work of Friedman (1956) and Tobin (1961, 1969).

²⁶Primarily changes in the composition of the balance sheet of the central bank

reasons why assets are not perfect substitutes, with the most frequently cited justification being related to investor maturity preference and the pricing of duration risk (Joyce et al., 2012a)²⁷.

In the preferred habitat model investors have specific preferences for assets of a certain maturity (segment of the yield curve / investment horizon), such as the preference of pension funds to invest in longer-dated securities (D'Amico et al., 2012). Purchases by the central bank in this model matter for bond yields, as private sector agents will try to rebalance their portfolios once open market operations have been performed on specific market segments (D'Amico et al., 2012). This is illustrated in the general equilibrium models of Andres et al. (2004), Vayanos and Vila (2009), Harrison (2012), and Chen et al. (2012a). All these papers feature a preferred habitat approach and construct a segmented market model with imperfect asset substitution.

Generally, these models have two types of agents: I refer to them as preferred habitat investors and arbitrageurs, as stipulated in Vayanos and Vila (2009)²⁸. Preferred habitat investors are inclined to purchase securities of a certain maturity²⁹, while arbitrageurs are not limited to a particular investment horizon. The model of Andres et al. (2004) puts the ideas of Tobin (1969) into a general equilibrium setting, modelling preferred habitat investors who are interested only in marketable, long-term fixed-income securities (D'Amico et al., 2012). With this, they try to capture the idea that changes in the relative supply of assets can generate price changes.

Targeted purchases of assets of certain maturities can create shortages in that market segment which cannot be resolved completely through asset substitution. This creates a scarcity in these assets, which forces market prices to change. Some refer to this as the safety premium (asset scarcity) channel, as described by Krishnamurthy and Vissing-Jorgensen (2011)³⁰. Evidence is provided by Krishnamurthy and Vissing-Jorgensen (2011) that in a preferred habitat environment which operates only in the space of safe assets, the presence of investors in long-term safe assets lowers the yield on those assets³¹. Investors in this setting are willing to pay a safety premium for assets with a low default risk.

The model of Andres et al. (2004) highlights the importance of the heterogeneity of agents in establishing imperfect asset substitutability. However, in this model the possibility exists that arbitrageurs can eliminate the trades made by long-term bond investors, which would yield an

²⁷The introduction of transaction costs, capital constraints, and other financial frictions could in combination generate this result (Bernanke et al., 2004).

²⁸Andres et al. (2004) refers to them as restricted and unrestricted households, but the idea is the same. In his model the restricted household (preferred habitat investor) is only allowed to purchase long-term securities, while the unrestricted household (arbitrageur) has access to both short- and long-term assets.

²⁹Normally long-term safe assets with zero risk for default, such as those invested in by pension funds (Krishnamurthy and Vissing-Jorgensen, 2011).

³⁰The asset scarcity channel pertains only to liquid, safe assets, such as Treasury bonds.

³¹Empirical evidence is discussed in more detail in Section 4.

irrelevance result. In their work Vayanos and Vila (2009), try to elicit portfolio balance effects by making the arbitrageurs risk averse³². Risk aversion, or even capital constraints on arbitrageurs, could limit arbitrage in these markets so that asset prices are indicative of segmented investor valuations (IMF, 2013).

5.1.3 Duration Risk Channel

In the model presented by Vayanos and Vila (2009) there is another portfolio balance mechanism at play, besides the scarcity effect, called the duration risk channel, also emphasised by Gagnon et al. (2011). Fixed income assets like long-term government bonds usually carry a term premium, as they are susceptible to future movements in the interest rate (Bowdler and Radia, 2013). The uncertainty associated with longer term securities is called duration risk. Intervention by the central bank in long-term asset markets, for example, changes the duration risk.

If the central bank were to purchase a large quantity of long-term bonds in a specific market segment, it would decrease duration risk (making the investors' portfolios safer) by removing a portion of long-term securities and thereby reducing long-term yields. Importantly, this effect flattens the entire yield curve (spread between long- and short-maturity bond yields), instead of just the segment where purchases were made, as in the scarcity channel (Krishnamurthy and Vissing-Jorgensen, 2011). This duration risk channel was thought to be of great importance during the recent financial crisis. The model of Chen et al. (2012a) is an extension of the work of Vayanos and Vila (2009) and attempts to develop a DSGE model of the large-scale asset purchase programs of the US. They found that the programs achieved the greatest success in reducing risk premia; or, in other words, operating through the duration risk channel.

5.1.4 Reserve- vs Supply-induced Portfolio Balance Effects

As first pointed out by Bernanke and Reinhart (2004), as well as later argued by Woodford (2012), a 'pure' form of quantitative easing exists, whereby the change in the size of the central bank balance sheet only entails a shift in reserves. In a recent paper Christensen and Krogstrup (2016) make a distinction between reserve- and supply-induced portfolio balance effects. The supply-induced portfolio balance channel is the one usually stressed, whereby the relative change in assets supply results in a change in the price of close substitutes.

³²An alternative would be to place a credit constraint on investors, as in (Gertler and Karadi, 2011)

However, there might also be a reserve-induced portfolio balance channel that reflects the effect from ‘pure’ quantitative easing, where an increase in reserves will increase a broad range of asset prices. In particular, the idea is that this reserve-induced channel might impact on long-term yields. According to Christensen and Krogstrup (2016) the reserve-induced portfolio balance effect can only be identified with “a substantial increase in the amount of central bank reserves, [which] is achieved without acquiring any long-lived securities or close substitutes thereof”. This channel is thought to exist because of one special property of reserves, they can only be held by eligible banks.

Using a specific case study of the Swiss National Bank, they are able to identify the overall impact from the reserve-induced portfolio balance channel. They find that it contributes significantly to decreasing the yield on long-term rates, without impacting on long-term Swiss bonds or their close substitutes. It is then argued that this reserve-induced channel might have played a substantial role in driving down long-term rates in the the QE programs implemented by the US, UK, ECB and Japan in recent years.

As originally argued in Bernanke and Reinhart (2004) and later reiterated by Kandrak and Schlusche (2015) and Christensen and Krogstrup (2016), increases in reserves can have an impact on the broader economy beyond changing the relative supply of assets. Little research has been performed on this component of the portfolio balance channel. However, with central banks across the globe significantly increasing reserves in the last decade, more research will try and determine the position of reserves in the range of transmission channels.

5.1.5 The Irrelevance Result and the Portfolio Balance Channel

During the 1970s and 1980s the expectations theory was the prevailing doctrine on long-term interest rate determination (D’Amico et al., 2012). In fact, in this period few researchers and policymakers were convinced about the relevance of balance sheet policies along the portfolio balance channel. While the expectations hypothesis was instrumental in guiding beliefs about the term structure of the interest rate, the work of Wallace (1981) contributed significantly to the exclusion of the portfolio balance channel from formal economic models. He postulates that open market operations - in an economy with complete markets, where government bonds of a certain maturity are exchanged for assets of different maturity - have no real economic effect, often referred to as the irrelevance result or Wallace neutrality³³.

Naturally, a prime example of where agents are thought to be indifferent among options is at the ZLB. Once this bound is reached and the central bank decides to intervene through a purchase

³³Sargent and Smith (1987) corroborate the message of Wallace (1981).

of short-term bonds, the market will react by balancing its portfolio toward money holdings (Krugman, 1998; Svensson, 1999). In this setting the central bank asset purchases have no impact on the real economy because both assets are largely risk free and bear no interest.

Owing to the irrelevance result (and the dominance of the expectations hypothesis), the portfolio balance mechanism has been largely missing from modern New-Keynesian macroeconomic models. Asset pricing in the traditional New-Keynesian model, see Woodford (2003), is usually framed in terms of two assets, money and bond holdings. In the case of consumers being indifferent between holding money versus bonds, agents consider the assets to be perfect substitutes at the ZLB (Bowdler and Radia, 2013). This explanation, which is similar to that of the Ricardian equivalence or Modigliani-Miller theorem, hinges on the fact that private sector agents will internalise the asset acquisitions of the central bank (Bean et al., 2010).

The model of Eggerston and Woodford (2003) formalises the irrelevance result in a general equilibrium setting with the nominal interest rate at the ZLB, proving that in frictionless financial markets, balance sheet actions are ineffective. Operations are considered even neutral in the exchange of reserves for longer-term securities (Chen et al., 2012a). In the absence of frictions, assets purchased by the central bank are equivalent to reserves, implying no policy impact. However, there is little practical support for this result (Bean et al., 2010).

In a response to criticism of their earlier work, Cúrdia and Woodford (2010) developed a model that considers the potential of a central bank balance sheet as a policy tool. This model is similar to that of Eggerston and Woodford (2003) but includes vital credit frictions that generate the desired non-neutrality in credit policy. In terms of the typology of Borio and Disyatat (2010), credit policy can work when supply-side frictions are imposed; however, there is no role for quasi-debt management in this model.

5.2 Signalling Channel

One of the most important tools at the disposal of the central bank is its ability to shape the expectations of market participants (Bernanke and Reinhart, 2004). The signalling channel is the primary channel through which monetary policy is thought to affect the longer-term interest rates when assets are perfect substitutes (D’Amico et al., 2012; Joyce et al., 2014). Asset purchases by the central bank, as argued by Eggerston and Woodford (2003), could lower long-term bond yields if they serve as a commitment device to keep the short-run policy rate lower in future³⁴. In other words, they reveal information that changes market expectations

³⁴This might mean keeping the rate below what is prescribed by an interest rate rule, such as the Taylor rule.

about key factors that determine the asset's price. These factors include "expectations regarding the future course of policy, relative scarcities of different assets or their risk and liquidity profiles" (Borio and Disyatat, 2010).

Clouse et al. (2003) argue that if the central bank purchased a large number of long-term bonds and then raised the short-term rate, it would expose itself to capital losses on the assets purchased. Financial market participants might view these purchases as a credible commitment not to deviate from its easy monetary policy stance; that is, if they believe that these losses enter into the central bank's objective function (Bowdler and Radia, 2013). Interestingly, signalling affects all bond rates, since the lower yield on Treasury securities is thought to affect all rates in the market via the expectations hypothesis (as previously discussed) (Krishnamurthy and Vissing-Jorgensen, 2011).

5.3 Liquidity Channel

A potential third channel is called the liquidity channel and is mostly applicable when financial markets are dysfunctional (Bowdler and Radia, 2013). In this channel the central bank purchases long-term illiquid securities and issues reserves, with reserves being more liquid than long-term securities. Distressed financial markets generally result in a decrease in wholesale funding, which leaves many firms liquidity constrained. Central bank asset purchases when financial market functioning is impaired can increase investor liquidity and reduce the liquidity premia (Krishnamurthy and Vissing-Jorgensen, 2011). This means that yields on the most liquid assets will increase, relative to other assets. During the crisis other plausible transmission channels were suggested, but at the moment there is no consensus over their inclusion in a larger typology. These channels are described as they are encountered throughout the rest of the thesis.

Conclusion

In this section I discussed the various dimensions of balance sheet policy. The primary contribution of this section, as with most literature reviews, is to aggregate relevant passages in the literature in such manner as to construct a coherent narrative. First, I provided an historical account on the use of balance sheet policies, with specific reference to the case of Japan. Operating under threat of deflation, with conventional policy tools exhausted, encouraged Japanese authorities to experiment with new monetary policy instruments. Not only did this provide a

training ground for the development of their quantitative easing program, it motivated research on a topic long-forgotten.

In retrospect, the Japanese experience provided invaluable preparation in dealing with the global collapse. In response to the crisis, several central banks had no choice but to relinquish the usage of their nominal overnight interest rate as policy tool, quickly shifting policy responsibility to their balance sheets. For example, once the zero lower bound was reached in the US, large-scale asset purchases and establishment of liquidity facilities were expeditiously carried out. The rapidity of response might have been slowed if it were not for the lessons learnt in Japan.

While it is widely understood that during the crisis central banks used their balance sheets to restore order to dysfunctional financial markets - and more broadly the monetary transmission mechanism - the nature of these policies and their implementation is often severely misunderstood. Correcting confusion with respect to balance sheet policy implementation and channels of transmission was a central objective of this review. In order to facilitate understanding, balance sheet policies were codified in terms of both broad and narrow typologies. In the broad sense, balance sheet policies are conducted along the dimensions of size and composition, while the narrow typology captures greater nuance with reference to asset classes affected by operations. Precise definition is important, as future discussion on the channels of transmission rely on a narrow understanding of balance sheet policies.

Part II

Balance Sheet Policies II: Financial Crisis and Policy Response

The most difficult subjects can be explained to the most slow-witted man if he has not formed any idea of them already; but the simplest thing cannot be made clear to the most intelligent man if he is firmly persuaded that he knows already, without a shadow of a doubt, what is laid before him.

— Leo Tolstoy (1894)

In the years preceding the global financial crisis it was argued that the *science* of monetary policy was starting to develop, owing to contributions of “rigorous theory and empirical work” (Mishkin, 2007). A consensus had been reached. The success of inflation targeting meant that “monetary policy could sustain low inflation with low unemployment on average, and with infrequent, mild recessions” (Goodfriend, 2007b). The last decade has proven that the consensus might have been premature, with declarations of monetary policy as science quickly quashed. What was previously thought to be certain, was perhaps a case of academic hubris.

6 The Financial Crisis (2007 - 2008)

The initial deflation diagnosis in Japan caused lively debate in the academic community as to the possibility of its incidence in other industrialised nations (Eggerston and Woodford, 2003). With interest rates already low in many developed countries in response to low inflation and slowed economic growth in the industrialised world, the possibility of a binding constraint on interest rate policy became a sobering reality. This was particularly true in the case of the USA, with concerns over deflation being resurrected with the recession in 2001.

An extensive literature emanated from this discourse, revealing potential policy predicaments and complementary solutions. Naturally, one of the concerns with a liquidity trap is that real interest rates will be too high to stimulate economic activity³⁵. Several strategies were

³⁵This is if we calculate real interest rates to be the sum of the nominal and inflation rates, as specified by Fisher (1930).

proposed as alternatives when short-term interest rate policy is constrained by the lower bound. An examination of the literature shows that, in order to combat this deflationary trap, an appropriate communication strategy, often in conjunction with nonstandard policy measures, is a suitable cure (Bernanke et al., 2004)³⁶. The biggest challenge, then, faced by central banks (especially those who suffer from a lack of credibility) is to convince the public that they are willing to commit to a sustained future expansionary policy. However, central bankers and academic economists, under the influence of the overwhelming success of the much-lauded New Neoclassical synthesis in monetary policy, have lost interest in the topic of deflationary traps (Goodfriend, 1997; Woodford, 2003).

6.1 Flexible Inflation Targeting

After the initial rush of research on Japan, economists considered the idea of deflation as no more than a passing theoretical curiosity (Woodford, 2012). Progress in terms of monetary theory instilled a confidence that even in advanced economies with low rates of inflation and interest, the ZLB would not plausibly be reached (Orphanides and Wieland, 2000). This false sense of security came from the apparent success of monetary policy in taming inflation (in terms of its level and variability) during the period known as the Great Moderation. This period, between the mid-1980s and 2007, was characterised by decreased business cycle volatility and low and stable inflation in most of the developed world. Apparent advances in theory, corroborated by empirical evidence, led researchers and policymakers to state that monetary policy had ventured into the territory of being called a science³⁷ (Clarida et al., 1999; Mishkin, 2007; Galí and Gertler, 2007; Goodfriend, 2007a; Taylor, 2007b).

It was believed that the focus of monetary policy in controlling inflation, by managing expectations of future policy rates (and thereby the long-term rate), made these advances possible (Svensson, 2003). In other words, optimal monetary policy was centred around the concept of a flexible inflation targeting regime with a symmetric target³⁸. Under such a system, deflation could be avoided. Generally, a nominal anchor has two important features that could help in avoiding deflation. First, an inflation targeting regime was believed to have better fixed the expectations of the market on the nominal anchor, in the process helping to avoid deflation

³⁶This strategy was referred to by Svensson (2003) as a foolproof way of escaping from a liquidity trap.

³⁷In fact, the famous 1999 article by Clarida, Gali and Gertler is called *The Science of Monetary Policy: A New Keynesian Perspective*. The idea of the economist as a scientist is challenged in the article by Mankiw (2006), who likens economists more to problem-solving engineers.

³⁸According to the flexible inflation targeting framework, optimal monetary policy steers to a constant long-run average rate of inflation. Fluctuations in the short-run are tolerated in order for policy to affect real activity, but inflation should not move away from the established long-run level for too long (Woodford, 2012)

(Woodford, 2003). Once again, for this strategy to be successful, communication on the part of the central bank is crucial. A commitment to a nominal anchor removes policy flexibility, improving the accountability and transparency of the policy.

Second, as argued by Ahearne et al. (2002), modern economies in a low-inflation environment faced with a negative shock could apply an aggressive reduction in the policy rate and thereby avoid the liquidity trap. Research by Harrigan and Kuttner (2004) on optimal monetary policy in Japan, using a Taylor rule, revealed that a credible nominal anchor (specifically an inflation target) would have guided their policy formulation so as to avoid the situation. Academics and government officials alike agreed that the economic slump of Japan in the 1990s was poorly handled by policymakers, in that the BoJ did not react swiftly and aggressively enough in the years preceding the deflationary spiral to prevent it (Ito and Mishkin, 2006). As stated by the previous BoJ Governor, “the low growth in Japan following the bursting of a bubble was often simply interpreted as a unique episode caused by a failure to implement bold policy measures in a prompt manner” (Shirakawa, 2013).

Empirical evidence presented by Bernanke and Gertler (2000), Jinushi et al. (2000), McCallum (2003), and Taylor (2001) indicates that policy was too tight after 1992 and that the policy rate should have been reduced much earlier. Studies on the efficacy of policy were focused on policy rate rules and the credibility that these rules afford (Blanchard, 2011). In particular, optimal monetary policy during this period was conducted with a focus on Taylor rules. In this setting, the optimal level of the short-term interest rate was determined by the distance from the output and inflation gaps (Taylor, 1999). Central banks before the crisis paid great attention to output gaps and inflation expectations, often neglecting issues of financial instability and the formation of asset bubbles (Shirakawa, 2013).

6.1.1 Inflation Targeting and Financial Stability

A monetary regime that produces aggregate price stability will, as a by-product, tend to promote stability of the financial system.

— Claudio Borio and Philip Lowe (2002)

Historically, policymakers were concerned with both price and financial stability. In fact, as argued by Goodhart (1988), central banks were initially created to prevent financial crises and bank failures that resulted from the “free banking” systems. However, there are several reasons why discussions on the central bank’s role in achieving financial stability have been muted.

First, the financial sector risk was not taken into account in determining the appropriate stance of monetary policy, as central banking was too narrowly focused on price stability (Borio, 2011). It is argued that the capacity of the central bank to combat asset price movements and the build-up of financial instability with conventional policy tools is limited (Woodford, 2010). The magnitude of the change in the nominal short-term interest rate might have to be quite large to combat asset price movements. This might be detrimental, as it could derail the inflation objective. For example, in their seminal article Bernanke and Gertler (2001), argue that monetary policy should be concerned only about factors that could plausibly influence inflation projections³⁹. In their study they found that the central bank gains relatively little from responding to asset price movements, and it should consider asset price fluctuations only in its capacity to affect the forecast of inflation, referred to as the “benign neglect” approach. In addition, the increase in the interest rate might impact asset classes beyond the one where a bubble is developing (Woodford, 2010). This means that perhaps targeted instruments, such as macroprudential regulation, would be more appropriate.

In fact, after the financial crisis there was a resurgence in the literature on the interaction of monetary policy and financial stability. In an article by Smets (2014), he argues that “price stability has proven not to be a sufficient condition for financial stability and lack of financial stability can have large negative feedback effects on price stability”. In his article he calls for macroprudential regulation to run complementary to monetary policy in dealing with the buildup of financial imbalances. Monetary policy should be able to lean against the wind in the short-run, coordinated with macroprudential policy, while focusing on price stability in the medium-term (Smets, 2014).

Second, measurement of the build-up of risk has been problematic. For example, it has proven almost impossible to identify asset price ‘bubbles’⁴⁰ until they have burst. Without a proper method for identifying bubbles, it is not considered worthwhile for the central bank to try and lean against asset price increases through contractionary policy. This has led academics and policymakers alike to suggest mopping up after the bubble has burst. However, as evidenced by the recent crisis, this might prove too costly. On the other hand, one thing gained from the crisis is that the overvaluation of an asset and the accompanying drop in price is not always the issue that needs to be addressed. The important consideration is the development of systemic risk that poses a threat to the health of the overall financial system, in other words, the joint failure of systemically important financial institutions. In this sense there have been significant improvements in the measurement of risk to financial stability (Woodford, 2010).

³⁹Before the financial crisis, this was referred to as the Jackson Hole Consensus.

⁴⁰A situation in which the price of an asset exceeds its fundamental value.

Third, central banks generally adhere to the principal of one instrument for one target, often referred to as the Tinbergen principle. Relying on only the policy rate as the tool of monetary policy means that central banks have no power to navigate the financial stability space. One tool for two goals creates “conceptual and practical” confusion as to the ultimate objective, with communication becoming increasingly difficult (Svensson, 2012). Finally, regulation was thought to complement monetary policy and thereby take care of financial stability concerns, with microprudential regulation acting the as key policy tool. However, once the crisis had hit, this idea surrounding the tools available to the monetary authority with respect to financial stability changed dramatically, bringing the balance sheet of the central bank into contention (Blanchard, 2011).

6.2 Tension Before the Collapse (2007)

In early 2007 there were signs of an impending financial crisis, stemming from turmoil in the sub-prime mortgage market in the USA. Housing and credit bubbles had formed due to several factors, with a low interest environment in the US, the increasing use of structured finance, and deficient financial regulation considered proximate causes. This section is not an in-depth discussion on the most likely causes and mechanisms underlying the crisis; it is simply an overview of the relevant contributing factors. Giving a detailed account of the financial crisis is a difficult endeavour; as Gary Gorton (2012) puts it, “the wave of research on the crisis has already exceeded any single reader’s capacity, with the pace of new work only making it harder”. In fact, in a report to Congress in 2010 to explain the origin of the financial crisis, Mark Jickling (2010) identified 26 potential causes. Undoubtedly the list of causes has grown since then, and a discussion on each potential contribution is unfeasible.

6.2.1 Low Policy Rate Environment

The low policy rates of the early 2000s in the US were the result of historically low inflation during the Great Moderation and an active attempt by the Fed to dispel deflationary concerns in the wake of the mild 2001 recession⁴¹. In fact, Taylor (2007a) argues that rates were significantly lower than prescribed by rule-based optimal monetary policy mechanisms, such as the Taylor rule. Such an environment could plausibly induce a risk-taking attitude of investors in several ways, which Borio and Zhu (2012) call the “risk-taking channel” of monetary policy.

⁴¹After the bursting of the dotcom bubble.

Conventionally, when yields on safe assets are low, investors substitute toward higher-yielding risky assets, a phenomenon that was recorded in the build-up to the crisis, described as a “search-for-yield” (Rajan, 2005; Shirakawa, 2013). This was compounded by the fact that perceived risk was at an all-time low during the Great Moderation, as suggested by several measures of implied volatility (Bean et al., 2010). In addition, as argued by Adrian and Shin (2008) and Adrian et al. (2010a), the increase in the price of risky assets improves the balance sheet position of financial intermediaries⁴² and encourages them to take on more debt (either through the extension of loans or the acquisition of securities), which in turn fuels further asset price increases. This effect is amplified by the pro-cyclical capital requirements of the Basel II accord. Over time, owing to the limited number of ‘safe borrowers’ in an economy and the depressed interest margins of commercial and investment banks, increased loan provision translates into increased funding of risky projects, inducing a leverage cycle (Bean et al., 2010).

6.2.2 Securitisation

In order to frame better the context of the incentive structure faced by financial institutions, it is important to discuss the topic of securitisation and the introduction of structured financial instruments. In a low interest rate environment, where financial institutions were in a search-for-yield, they were incentivised to create structured financial instruments to boost profitability. Financial engineering allowed the transformation of a group of illiquid and possibly risky assets (such as mortgages) into an apparently low-risk security, through a process called securitisation (du Plessis, 2011).

6.2.2.1 Definition and History Traditionally, banks needed to fund loans issued to borrowers through the collection of deposits. Modern banking has grown significantly in terms of the sources of funding available, which now “include bond financing, commercial paper financing, and repurchase agreement (repo) funding” (Bord and Santos, 2012). A vitally important change in the lending structure of banks is the shift from the originate-to-hold model of lending to the originate-to-distribute framework (du Plessis, 2011). In the originate-to-hold model, loans are kept on the balance sheet of the originator, which provides an incentive to control the quality of the loan. The benefit of this model, as discussed in Ramakrishnan and Thakor (1984), Diamond (1984) and Holmstrom and Tirole (1993), is that banks are able to monitor borrower activity. With the originate-to-distribute model, “loans are pooled, tranced, and then resold via securitization” (Brunnermeier, 2009). Modern banks, therefore, are more concerned with

⁴²Commercial banks are looking to retain constant leverage ratios, but investment banks do not mind increased leverage in a boom period.

convincing potential investors of the quality of the loans underlying the asset pledged (du Plessis, 2011)⁴³. Credit ratings agencies helped to bridge the information gap between investors and financial institutions selling bundled cash flows.

According to Andersen et al. (2013), “[s]ecuritization means selling securities whose principal and interest payments are exclusively linked to a pool of legally segregated, specified, cash flows (promised loan payments) owned by a special purpose vehicle (SPV)⁴⁴”. In this setting, an SPV (i.e. the issuer) buys the rights to the cash flow of the pooled assets from an authorised loan originator (Gorton, 2015). Securities formed from the pooling of assets are referred to as asset-backed securities (ABS). After being packaged and assigned credit ratings⁴⁵, these ABS are sold in capital markets to fund the purchase of the loan portfolio (Andersen et al., 2013).

In the US this process led to the creation of mortgage-backed securities (MBS), which entailed collecting mortgages and bundling them into a security. Initially, securitisation of this type was performed only by government sponsored enterprises (GSEs), such as Fannie Mae and Freddie Mac. Due to the potential credit risk borne by these GSEs, the approval of mortgage loans was subject to a set of guidelines. Mortgage loans that fell within a prudent set of parameters were referred to as standard conforming loans (du Plessis, 2011).

The restrictions on loan eligibility were not politically popular, as the inability to qualify for conventional mortgages excluded a large portion of the population. In response, new mortgage classes, such as Alt-A and sub-prime mortgages were created, which allowed those with poor credit histories to be considered for loans (Taylor, 2008). The lowering of lending standards was considered largely to be a political initiative intended to increase homeownership among low-income households (Wallison, 2009). Due to their risky nature, interest rates on nonprime loans are significantly higher than the rate on prime loans (Acharya and Richardson, 2012).

One of the major contributing factors to the sweeping defaults and foreclosures of 2007 and 2008 was that a substantial proportion of subprime mortgage loans had adjustable rates, which were unwittingly structured in such a way as to create systemic risk. Adjustable rates meant that loans were offered at a fixed rate for a short period (a teaser rate), usually for the first two to three years, after which the rate floated at a variable rate with an additional premium (Acharya and Richardson, 2012). Financial institutions understood that a rate increase would result in either defaulting or refinancing for many clients. However, as long as the underlying asset

⁴³Investors need to be convinced, as banks are off-loading the risk associated with these loans onto investors.

⁴⁴SPVs in this context are legal entities created to fund a large pool of assets, by buying the right to cash flows from financial intermediaries.

⁴⁵Interestingly, securities created in the process of securitisation are considered ‘credit enhanced’, which means that the rating is higher than the underlying asset pool (i.e. unsecured debt from the originator)

price was increasing, borrowers could use capital gained from the appreciation as collateral to refinance their homes⁴⁶ (Gorton, 2008). With this mechanism in place, the probability of systemic default seemed remote.

6.2.2.2 MBS and Derivatives Along with adjustable rate mortgages and the reliance on appreciating house prices, the type of securitisation performed before the crisis also significantly contributed to systemic risk, as it “eroded loan quality” and caused a “lack of transparency about the quality of the loans” (Jaffee et al., 2009). Usually, the issuer of the security divides it into tranches, and each tranche is assigned a specific credit rating. AAA-rated, senior tranches were considered the safest investment by credit rating agencies⁴⁷. Ratings were based on both the individual probability of default (i.e idiosyncratic risk), as well as on the correlation of default across all securities in the pool (i.e systematic risk) (Gorton, 2010). Market participants looking for low-risk, stable investments - such as pension funds - looked to the safer senior tranches, while riskier investors purchased securities from the lower-rated and higher-yielding tranches.

The most basic form of MBS is referred to as ‘pass-through’. A pass-through security is usually created by pooling a selection of assets and then allowing the sale of shares or participation certificates, allowing access to the pool. Shareholders then are passed through a pro-rata portion of the cash flow generated by the pool (Andersen et al., 2013). However, in order to generate an even greater selection of investment products, several mortgage derivatives were created. Among the most popular derivatives were the collateralised debt obligations (CDOs)⁴⁸.

The complexity and lack of transparency generated by securitisation is not fully appreciated until one delves into the topic of CDOs. Cash flow generated from the different tranches of MBS was often further segmented into structured asset-backed securities called CDOs, with sub-prime mortgages (i.e. the debt obligation) offered as collateral. While the structure of CDOs can be explained in different ways, I follow the layout of Gorton (2008) and Jaffee et al. (2009).

First, CDOs are divided into high-grade, mezzanine and equity levels. The majority (more than 95 per cent) of the cash flow from the top three tranches of MBS (AAA, AA, A) was directed at senior high-grade CDOs (Jaffee et al., 2009). Mezzanine CDOs are usually formed from the middle, riskier tranches of the MBS. Equity CDOs are formed from the bottom tranche and are

⁴⁶Interestingly, refinancing of existing mortgages formed the bulk of origination in the sub-prime mortgage market (Bhardwaj and Sengupta, 2008).

⁴⁷Tranches range from the safe senior level to risky junk bonds, with the yield increasing as you move to the riskier tranches.

⁴⁸While it is rather confusing, a CDO is still considered an MBS.

considered junk bonds, or “toxic waste” (Brunnermeier, 2009). In this setup the high-grade CDOs get paid first in the case of a default, with mezzanine paid next and the equity tranche paid only after the others receive payment⁴⁹.

Second, adding another level of complexity, both the high-grade and mezzanine levels are portioned into discrete tranches, with different ratings of default risk assigned to each tranche (Acharya and Richardson, 2012). The equity tranche is usually held by the issuing bank, in order to monitor borrowing activity (Brunnermeier, 2009). On average, the more senior levels are divided into six or seven tranches. Effectively, this means that within the mezzanine CDO, which is formed from riskier MBS tranches, it is possible to create an AAA-rated MBS. With increased demand for AAA-rated securities, this type of financial engineering was encouraged. Third, the middle portion (normally AA and A rated securities) of mezzanine CDOs were often repackaged as CDO², which also delivered a significant portion of AAA-rated securities (Jaffee et al., 2009). As revealed during the crisis, correctly assigning risk to these structured securities is exceedingly difficult.

A lack of transparency, and a belief in the financial engineering⁵⁰ underlying the creation of CDOs led credit rating agencies to incorrectly assign inherently risky assets the highest possible credit ratings. This was, in part, because agencies believed the potential for large-scale default was improbable⁵¹ (du Plessis, 2011). Needless to say, ratings agencies underestimated the risk associated with these securities and their derivatives, which became evident when delinquencies started to increase in response to a turn in the housing market in 2006 (Ashcraft and Schuermann, 2008). Unfortunately, many securities firms held large quantities of these opaque assets on their balance sheets⁵².

6.2.2.3 Credit Default Swaps Security buyers could also try and protect their potentially risky investments by purchasing a credit default swap (CDS) contract. With a credit default swap, the seller of a CDS contract asks the protection buyer to pay a nominal fee (credit swap premium) to assume the credit risk associated with a security⁵³. In the case that a negative credit event - such as a default - occurs, the seller of the CDS contract needs to pay the principal and interest on the referenced obligation, while the buyer delivers either the referenced asset or a settlement worth the market value of the bond (Acharya et al., 2012).

⁴⁹Referred to as a waterfall structure, where the benefits go to the top first and then flow down.

⁵⁰Market participants believed that the Gaussian Copula formula used was representing risk probabilities accurately.

⁵¹Credit rating agencies were also incentivised to assign high ratings. If they did not abide, financial institutions would simply move their business to another agency.

⁵²Usually the purchases of these assets are financed through repurchase agreements with commercial banks (Adrian and Shin, 2010)

⁵³This fee payment occurs periodically until the maturity of the CDS.

Before the crisis, CDSs were quite popular for insuring against the credit risk associated with CDOs and other MBS. In fact, the CDS market was one of the most rapidly growing markets before the crisis. In 1998 the notional amount of outstanding CDS contracts was about \$180 billion, expanding to a high of \$62 trillion in 2007 (Acharya et al., 2012). According to data from the Bank for International Settlements (BIS), the current size of the market is around \$12 trillion. The size of this market meant that in the case of a large-scale default, it might not be possible for the sellers of CDS risk contracts to meet their obligations. In this subsection some of the most important components of securitisation are detailed. What follows is a discussion on how these elements contributed to financial intermediation in the shadow banking system.

6.2.3 Shadow Banking System

Initially, the term shadow bank, which was coined by Paul McCulley in 2007, referred to “risky off-balance-sheet vehicles hatched by banks to sell loans repackaged as bonds” (Economist, 2016). However, shadow banking in its current incarnation has taken on a different meaning. There are multiple definitions on what constitutes the shadow banking system. Broadly speaking, as stated by Bernanke (2012),

Shadow banking, as usually defined, comprises a diverse set of institutions and markets that, collectively, carry out traditional banking functions - but do so outside, or in ways only loosely linked to, the traditional system of regulated depository institutions.

The primary function of the shadow banking system involves maturity transformation, in which “opaque, risky, long-term assets” are converted into short-term liabilities (Adrian et al., 2010b; Chan, 2012). In the chain of financial intermediation, purchases of MBS and CDOs by financial institutions, through off-balance-sheet structured investment vehicles (SIVs) and conduits, are usually financed through repurchase agreements with commercial banks. Lending by the commercial bank, in turn, is funded through issuing short-term liabilities. Financial commercial paper (CP) is a popular form of short-term paper offered by these banks (Adrian and Shin, 2010). Buyers of these liabilities include money-market mutual funds (MMMFs), often with household savers as shareholders.

Credit intermediation from shadow banking activities grew to equal that of commercial banks (i.e. traditional depository institutions) in the years before the crisis (Bernanke, 2013). Securitised portfolios were considered a source of collateral for funding under the shadow banking system. In addition, abiding by the Basel II accords, banks had to fulfil a certain capital adequacy ratio, with the safest tranches of ABS requiring less capital. During that time the economy

became reliant on seemingly low-cost shadow banking activities to supply short-term liquidity. These activities were facilitated by the use of off-balance-sheet vehicles.

6.2.3.1 Off-Balance-Sheet Activity As a point of clarification, structured investment vehicles (SIVs) and asset-backed commercial paper (ABCP) conduits are types of special purpose vehicles. These vehicles allow institutions to remove debt from corporate balance sheets, which reduces the exposure of their balance sheet to risk, often making them appear safer than they actually are. SPVs are legal entities that are created with one specific goal in mind. Earlier in the section I discussed SPVs that are involved in the process of securitisation, creating investment vehicles such as CDOs, CDSs and MBS. Securitised debt in this form is not kept on the balance sheet of the bank. Whereas the SPVs in securitisation are fully mechanical/robotic in their function, SIVs and ABCP conduits are actively managed companies. For example, the function of SIVs is to sell short-duration bonds, such as commercial paper, to MMMFs, which generates funds that are used to purchase long-duration securities - such as ABS - with high credit ratings (Gorton and Metrick, 2010).

SPVs were first mentioned in the process of securitisation, with operations being conducted off the balance sheets of banks. There are several benefits associated with conducting business in this manner. First, securitisation avoids the potential for bankruptcy⁵⁴. SPVs are constructed in such a way as to make the possibility of bankruptcy - voluntary or involuntary - sufficiently small (Gorton and Metrick, 2010). Second, off-balance-sheet securitisation is not subject to regulatory capital requirements, which affords them access to relatively cheap debt financing. Third, structures are put into place to avoid adverse selection⁵⁵. Some of the prominent features incorporated to eliminate adverse selection are eligibility criteria and warranties on the loans, as well as the maintenance of an equity position in the security by the originator (Gorton and Metrick, 2010). Finally, transparency is inherent in an SPV, with its portfolio being completely known (i.e. full disclosure is provided in terms of its balance sheet).

6.2.3.2 Leverage The increase in off-balance-sheet activity effectively allowed many financial institutions to avoid capital requirements. However, this also entailed an almost unrestricted increase in leverage. The ratio of assets to capital (equity) on a bank's balance sheet is known as leverage. When debt is in excess of equity, a bank is considered highly geared/leveraged (Adrian and Shin, 2010). In other words, increases in debt financing relative to capital financing

⁵⁴The paper by Klee and Butler (2002) provides a comprehensive account of how SPVs are structured in order to avoid bankruptcy.

⁵⁵In this setting, adverse selection might occur because loan originators have more information as to the quality of the loans selected for the portfolio purchased by the SPV.

increase the leverage. Equity is more costly to generate than debt, with servicing costs on debt being tax-deductible (Ingves, 2014). Firms that finance assets with debt, as opposed to equity, also improve their return on equity. This can be seen by the fact that leverage, in terms of financial institutions, is considered to be pro-cyclical, which means a “strongly positive relationship between changes in total assets and changes in leverage” (Adrian and Shin, 2010). Leverage is key to credit provision as it decreases financing costs for firms, as long as earnings exceed borrowing costs. However, the downside to excessive leveraging is that it can amplify liquidity spirals, as explained in the last part of this section.

While banks were already highly geared, the on-balance-sheet activities were regulated. One of the primary reasons why shadow banking grew so explosively is the fact that it was not prone to the same regulatory oversight as traditional banks. In particular, the creation of off-balance-sheet investment vehicles allowed banks to effectively circumvent risk-based capital adequacy ratios. This allowed these institutions to become highly leveraged off their balance sheets, while still conforming to regulatory capital requirements.

6.2.3.3 Regulation In the years leading up to the crisis, Alan Greenspan purposefully attempted to deregulate markets in the US, with the belief that they would be able to self-regulate. In this narrative, financial firms are the best equipped to regulate their own actions, with government regulation seen as cumbersome and inefficient (Born, 2011). The self interest of market participants would rule out excess, with tremendous amounts of government resources needed to perform this action effectively, possibly without improving the final outcome. In addition, several mechanisms were put into place by financial institutions to prevent excessive risk-taking. For example, balance sheets with securitised assets were considered healthy, as they contained assets with high credit ratings and therefore relatively low capital requirements (Bernanke, 2012). The creditworthiness of counterparties is based on the health of the balance sheet, which according to credit rating agencies and insurance companies, was considered safe (Gorton, 2014).

An emphasis on deregulation helped the largely unregulated shadow banking sector to rapidly evolve to match the size of the traditional banking sector. Several of these unsupervised financial institutions, outside of the commercial banks, achieved the same level of systemic importance (Born, 2011). The size of these institutions, linked with reduced regulation, had several important implications that contributed to the crisis.

First, there was limited regulatory oversight on the risk-taking behaviour and risk management strategies in the shadow banking system. While there was a degree of market discipline imposed

by market participants, it did not halt the development of systemic risk (Bernanke, 2012). In addition, the fact that there was no statutory authority limited the information available with regard to underlying risk.

Second, regulation focused mainly on microprudential supervision, which meant that authorities were concerned only with the safety of individual financial institutions (i.e. idiosyncratic risk) (Adrian et al., 2010b). After the crisis, macroprudential policy, which is directed at systemic risk, became the focal point. Interestingly, before the crisis, in many advanced economies, governments did not even have the authority to “limit systemic risks that could result from the collective behaviour of financial institutions and markets” (Bernanke, 2012). Not only did this contribute to the build-up of risk, but also to the ability of policymakers to combat it.

Finally, the procyclical nature of the Basel II accords, with capital requirements becoming easier to satisfy with the rise in asset prices, helped to fuel the asset market bubble (Goodhart et al., 2010). This allowed banks to increase their leverage in good times and, unfortunately, made it more difficult for them to maintain the requirement in times when credit was tight. In general, the booming economy led most financial institutions to hold less capital than they needed, with the potential for loss amplified in the case of a bust (Gorton, 2014).

In addition to the incentivised gearing through regulation, the central bank also contributed by creating moral hazard through its capacity as lender-of-last-resort (Gorton, 2010). Market participants were under the impression that once a crisis emerges, they would be considered too-big-to-fail. This belief was institutionalised, in part, from the Bagehot principle, in which the central bank is obligated to assist financial institutions regarded as systemically important. ‘Bagehot’s dictum’, as summarised by Tucker (2009), is that “to avert panic, central banks should lend early and freely (i.e., without limit) to solvent firms, against good collateral, and at ‘high rates’”.

6.2.4 Housing Market Collapse

At the start of 2007, house prices were on a downward trajectory, accompanied by a wave of foreclosures, as teaser rates on adjustable-rate mortgages came to an end. Sweeping defaults raised the question as to the values of a wide range of mortgage-related securities. Private sector agents found it increasingly difficult to determine their own risk exposure, especially when it came to off-balance-sheet investment vehicles (Bernanke, 2012). This section describes the amplifying factors that transformed the turmoil in the housing market into a full-blown

financial crisis. Brunnermeier (2009) identifies four crucial amplification mechanisms. However, only the first two are relevant to our discussion.

First, a negative shock to asset prices could severely impact the balance sheets of borrowers. Highly leveraged investors facing a decline in asset prices could potentially trigger a *loss spiral*. This is best explained by an example, as in Brunnermeier (2009). Let us consider investors who purchase assets to the value of \$100 million with a haircut of 10%. In order for the investors to purchase these assets, they need to put up \$10 million of their own capital, while funding the rest with debt. In this case, the leverage ratio is calculated at 10. Suppose a shock to the economy causes the asset price to decline, which leaves the market value of the investors' assets at \$95 million. In this case, the decrease in the value of the assets has caused the investors' capital to decline, from \$10 million to \$5 million.

The loss in capital experienced by the investors mean that they must reduce their asset position in the market, in order to retain the same leverage ratio. In this case, the bank has only sufficient capital to hold \$50 million worth of assets. The investors are now forced to sell \$45 million worth of assets in order to achieve this position. However, the sale of these assets further depresses the price, which leads to an iterative process of asset sales and price reductions. In this example haircuts are kept constant but in the case of the crisis a *margin spiral* also emerged. During periods of financial distress, borrowers tend to increase haircuts, which means that investors need to offer up more capital to purchase assets. This intensifies the effects of the loss spiral. Together the loss and margin spiral form what is referred to by Brunnermeier and Pedersen (2009) as a "liquidity spiral".

Losses experienced were concentrated "disproportionately at key nodes of the financial system, notably highly leveraged banks, broker-dealers, and securitisation vehicles" (Bernanke, 2012). Due to high leverage, the losses quickly consumed the capital of these institutions, leaving them only debt and causing broad-scale insolvency. Following this there was an attempt to deleverage, but due to the inability to sell mortgage related securities in repo markets, this prompted sales into illiquid markets. Fire sales of assets outside of the housing market ensued as banks scrambled for liquidity in order to meet the capital requirements of the Basel II accord (du Plessis, 2011). Sales decreased prices on assets sold, which further weakened balance sheets. Rapid asset sales further promoted the unwillingness to lend, as counterparties exposed to toxic assets were considered desperate.

Second, shocks to the economy can operate through the lending channel (Brunnermeier, 2009). The balance sheets of borrowers form only one side of the equation. Supply-side constraints generate shortages in liquidity, which means that lenders might not be able to meet demand,

even if borrowers are solvent. Lenders with limited amounts of capital might start to hoard liquidity in a precautionary manner, in fear of worsening financial conditions. Uncertainty as to the asset positions of other intermediaries made these banks hold on to their assets.

This behaviour could be explained with reference to the repo market. As previously discussed, this is the link in the financial intermediation chain whereby financial institutions convert their long-term illiquid assets into short-term debt with commercial banks. In order to obtain short-term funding, financial firms offer their mortgage securities as collateral. A halt in the process of intermediation resulted from uncertainty as to the quality of assets offered as collateral. In other words, liquidity from the interbank markets was drying up as commercial banks were becoming increasingly unwilling to provide liquidity, in the fear that they would not see repayment (Acharya and Richardson, 2012). Commercial banks responded by increasing the haircut requirements on collateral. This effectively shut many financial institutions out of the wholesale market, as they were unable to transform their illiquid securities into short-term debt. Trust in the ability of counterparties to meet their obligations was broken (du Plessis, 2011).

The trend of asset price increases precipitating a crisis is a familiar one, as according to the work of Reinhart and Rogoff (2009), most of the economic crises of the past two centuries have been preceded by rapid credit expansion and the accompanying creation and collapse of bubbles. In other words, asset price increases and excessive risk-taking created distorted incentives for banks and accelerated credit expansion and overall leverage to abnormal levels (Adrian and Shin, 2011). In conjunction with lax regulations and information problems in assessing the underlying value of asset-backed securities, this created the perfect storm for a financial crisis. Eventually, the realisation dawned that even with inflation targeting, the focus on price stability is not a guarantee against financial instability (Borio, 2011).

6.3 Creating Liquidity Facilities (2007)

During 2007 the Federal Reserve responded to the credit crunch by cutting the policy rate incrementally on several occasions, in order to stimulate activity. The extent of the crisis was not known at this time, but owing to the experience of Japan, it was crucial for the central bank to be aggressive in its approach to easing (Ahearne et al., 2002). Credit ratings agencies placed several securities backed by subprime mortgages on credit watch, while various financial institutions (in the US and abroad) started reducing their exposure to MBS.

Once the Fed realised that dysfunctional financial market conditions were not improving, it further decreased the policy rate in the hope that it could avoid a recession. However, pressure

in the financial market did not abate, and liquidity shortages on the interbank funding market became commonplace, with large spikes in the LIBOR-OIS⁵⁶ spread, referred to as “illiquidity waves” (Sengupta and Tam, 2008)⁵⁷. A widening of the bid-ask interest rate spread generally means that collateralised borrowing is constrained (Dicecio and Gascon, 2008).

In order to address the widening spread between the overnight and interbank rates⁵⁸, the Fed introduced a variety of liquidity facilities. This credit policy was meant to operate primarily through the liquidity channel, providing liquidity to distressed financial institutions (Sack, 2009). The first in the long line of broad-based liquidity facilities created by the Fed was the Term Auction Facility (TAF) for depository institutions, which was established in December 2007⁵⁹. At roughly the same time, similar actions were undertaken by other central banks, such as the Bank of Canada, BoE and ECB⁶⁰. The TAF is considered the first implementation of the central bank balance sheet. It can be filed under a change in the composition of the balance sheet⁶¹; this is a sterilised operation whereby assets and liabilities on the balance sheet are increased in equal amounts.

6.4 The Collapse of Lehman Brothers (2008)

In 2008 the housing bubble burst, with the decrease in housing prices resulting in increased delinquencies and foreclosures (Bernanke, 2008). Mortgage markets experienced a significant downturn, and financial institutions exposed to these markets were heavily affected, suffering losses in terms of capital and liquidity (Labonte, 2015). Affected institutions became increasingly reluctant to extend loans of any type to consumers and firms, which had a particularly severe impact on residential construction (Bean et al., 2010). The extent of the impact was exemplified by the fact that even two GSEs, Fannie Mae and Freddie Mac, needed massive intervention (Bernanke, 2009).

⁵⁶Bid-ask interest rate spreads.

⁵⁷Several significant events contributed to these illiquidity waves. These include the emergency funding to UK mortgage lender Northern Rock (85 bp), several writedowns by large American investment banks such as UBS and Lehman Brothers (108 bp), and the eventual sale of Bear Sterns to JP Morgan Chase in March of 2008 (83 bp). However, by far the largest increase in spread came from the failure of Lehman Brothers in October 2008; a massive 365 basis points.

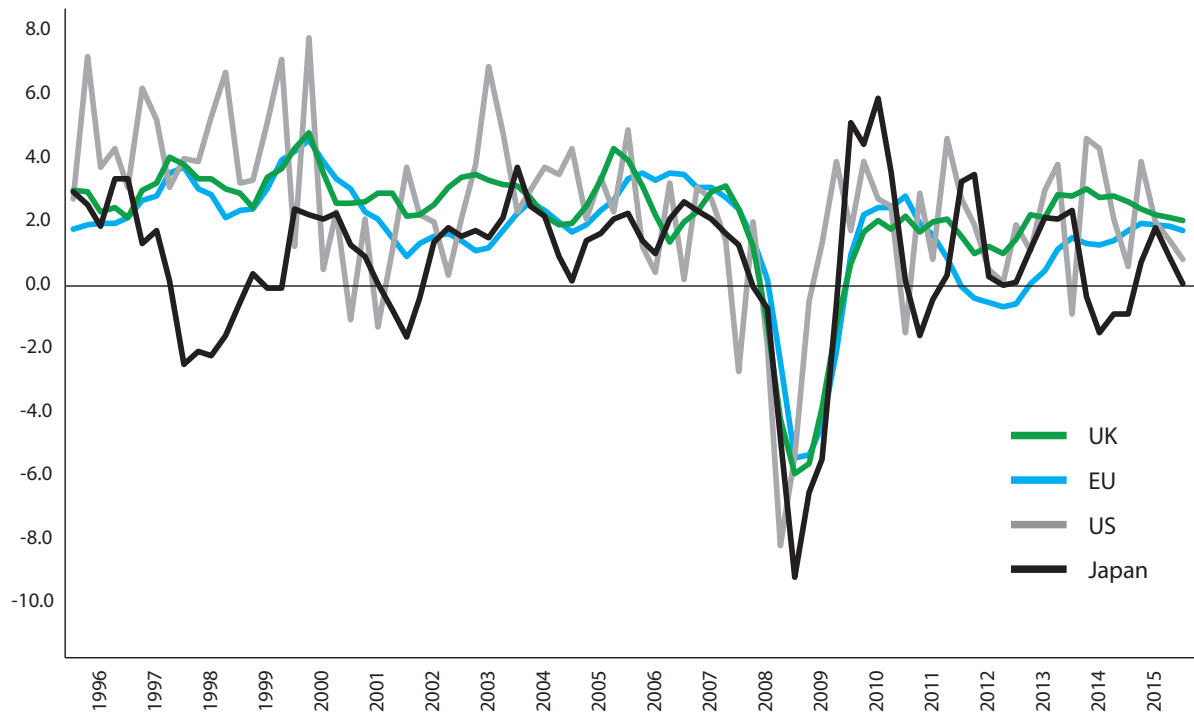
⁵⁸Usually of maturities beyond the short overnight rate. Indicative of a liquidity premium.

⁵⁹This facility was similar to the normal discount window, but it was anonymous. This avoided the stigma attached with going to the discount window; which is one of the reasons that the interbank market liquidity dried up in the first place (Wheelock, 2008).

⁶⁰Swap lines were also established with ECB and Swiss National Bank, in order to improve global credit flow.

⁶¹Considered a type of ‘credit easing’, as defined by Bernanke et al. (2004), or ‘credit policy’ as defined by Borio and Disyatat (2010)

Figure 4: Real GDP growth of four countries



Source: Bank of Japan; St Louis Federal Reserve Bank; European Central Bank; Bank of England

In order to improve credit conditions, the central bank reduced the policy rate even further, as seen in Figure 5. In March 2008, with funding markets' liquidity constrained, the Federal Reserve started a securities lending program⁶², called the Term Securities Lending Facility (TSLF). This program entails the swap of Treasury securities for other eligible securities, which is essentially a change in the composition of the balance sheet of the central bank. This facility is different than the TAF in that it includes a wider range of eligible securities, including several forms of agency debt and MBS (Dicecio and Gascon, 2008).

Finally, in addition to the TAF and TSLF, the Fed introduced the Primary Dealer Credit Facility (PDCF), an initiative that was initially different from the TSLF in that it accepted an even broader range of investment-grade securities as collateral. At this point in the crisis narrative, the balance sheet measures used were not considered strictly unconventional. These measures entailed an increase in the range of eligible collateral and counterparties, but purchases were highly collateralised and considered within the normal purview of central bank operations (Bean et al., 2010).

The US experienced the largest share of the turmoil, with many crucial financial players becoming heavily distressed and highly geared. Heavy involvement in the securitisation of

⁶²Started in unison with several other G-10 central banks.

mortgage-backed securities meant that investment bank Bear Sterns would be sold to JP Morgan Chase at a fraction⁶³ of its pre-crisis market value, a deal brokered by the New York Fed, which also provided the necessary term financing (Bernanke, 2009). In addition, several firms that werelinked to mortgage markets, such as the large savings and loan association IndyMac⁶⁴, started to collapse. Even the support provided to Fannie Mae and Freddie Mac was not sufficient, and they had to be taken into conservatorship, with the Treasury providing massive liquidity injections (Bernanke, 2009).

Fears of a systemic collapse was on the cards with continued liquidity frictions in the wholesale market and increasing risk premia. Unfortunately, the position of Lehman Brothers (one of the largest players in the US shadow banking system) was unsalvageable; despite efforts on the part of monetary and fiscal authorities, they filed for bankruptcy in September 2008. This bankruptcy raised concerns for the solvency of other financial institutions with similar asset profiles, such as the insurance company AIG⁶⁵ (which was eventually bailed out at the cost of \$85 billion) and investment bank Merrill Lynch (which was acquired by the Bank of America). In a strategic move to avoid further default, large investment firms Morgan Stanley and Goldman Sachs were approved to become bank holding companies, with direct access to the term lending facilities of the Fed. At this point, market participants had lost faith in highly leveraged financial institutions to meet their obligations, and coordination failures emerged (Falagiarda and Saia, 2013).

Shock waves from this event were felt across the globe, and policymakers started to comprehend the magnitude of the crisis. Central banks worldwide realised that if key institutions were allowed to fail, it would have a catastrophic impact on financial markets. Monetary and fiscal authorities across the globe started implementing expansionary policy measures, specifically with the goal of providing liquidity to financial institutions. As interest rates started circling the ZLB in December 2008, monetary authorities realised that they would have to provide stimulus through balance sheet policies (Labonte, 2015).

7 Four Balance Sheet Stories (2008 - 2016)

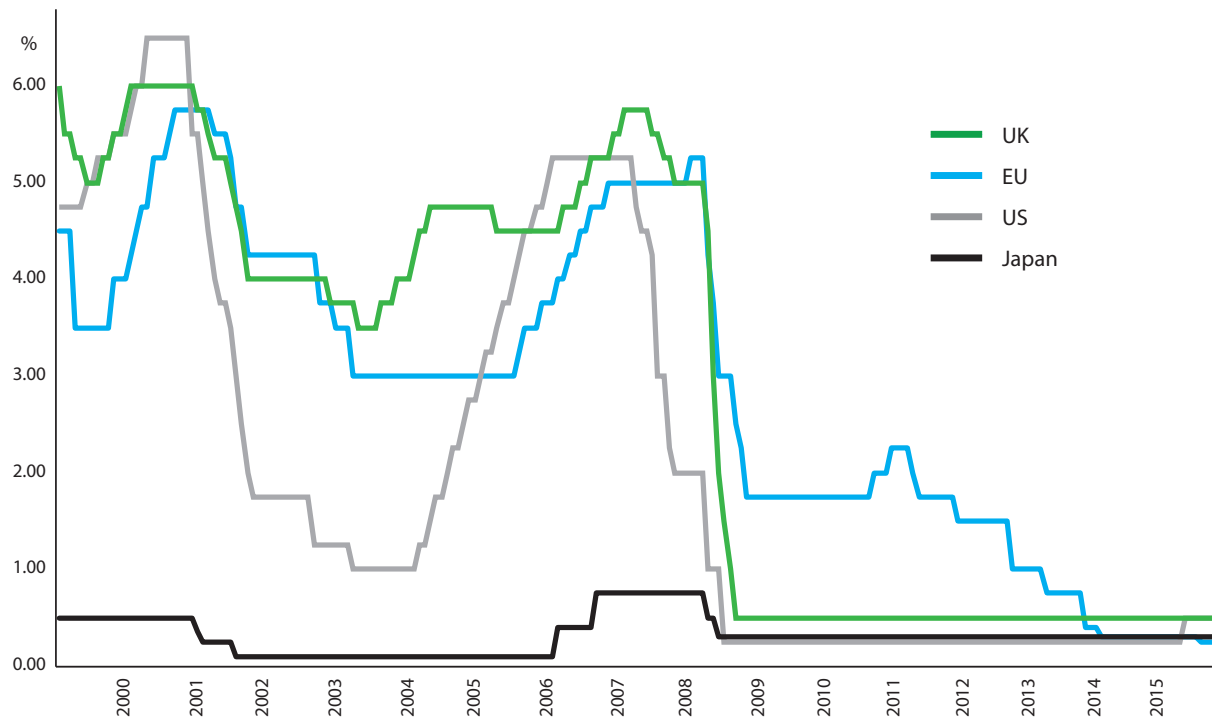
The fall of Lehman Brothers was the catalyst that escalated balance sheet operations by central banks across the globe. This section chronicles different liquidity management strategies

⁶³Their value dropped from more than \$133 per share to below \$2 per share after the crisis. The intervention of the Fed meant that Bear Sterns would be acquired for a more reasonable \$10 per share.

⁶⁴Independent National Mortgage Corporation.

⁶⁵Heavily invested in CDS. Default triggered the repayment on all the CDS contracts extended. This was simply too much to bear.

Figure 5: Short-term policy rates of four countries



Source: Bank of Japan; St Louis Federal Reserve Bank; European Central Bank; Bank of England

implemented by four influential central banks, namely the Fed, ECB, BoE and BoJ. It is important to gain some perspective on the balance sheet policies used by different countries, in order to determine whether there are some common trends. The goal of this section is to highlight the policies that have been used most widely and that have enjoyed the greatest longevity and success. This section is complemented by the next section, where the empirical evidence on the stated balance sheet policies implemented are discussed. Figure 6, Figure 7, Figure 8 and Figure 9 represent the different balance sheets of the four countries discussed. In addition, each figure contains country-specific timelines of the events mentioned in the section.

7.1 USA: The Federal Reserve

7.1.1 Liquidity Facilities

In most developed countries, banks can deposit or withdraw liquidity in the primary market, with the central bank, or in the secondary/interbank market (Catalão-Lopes, 2010). Open market operations⁶⁶ conducted with the central bank are secure, while the liquidity traded between

⁶⁶Also those conducted with standing facilities

banks carries some risk. A number of different facilities were established in order to quell fears over a pending recession and the potential collapse of secondary markets. Credit intermediation in the modern era increasingly is performed in financial markets, as only commercial banks have access to the relatively inexpensive funding provided in the federal funds market (Bernanke, 2009). The Fed was one of the first central banks to enact liquidity facilities to provide relief to struggling financial institutions and repair dysfunctional markets.

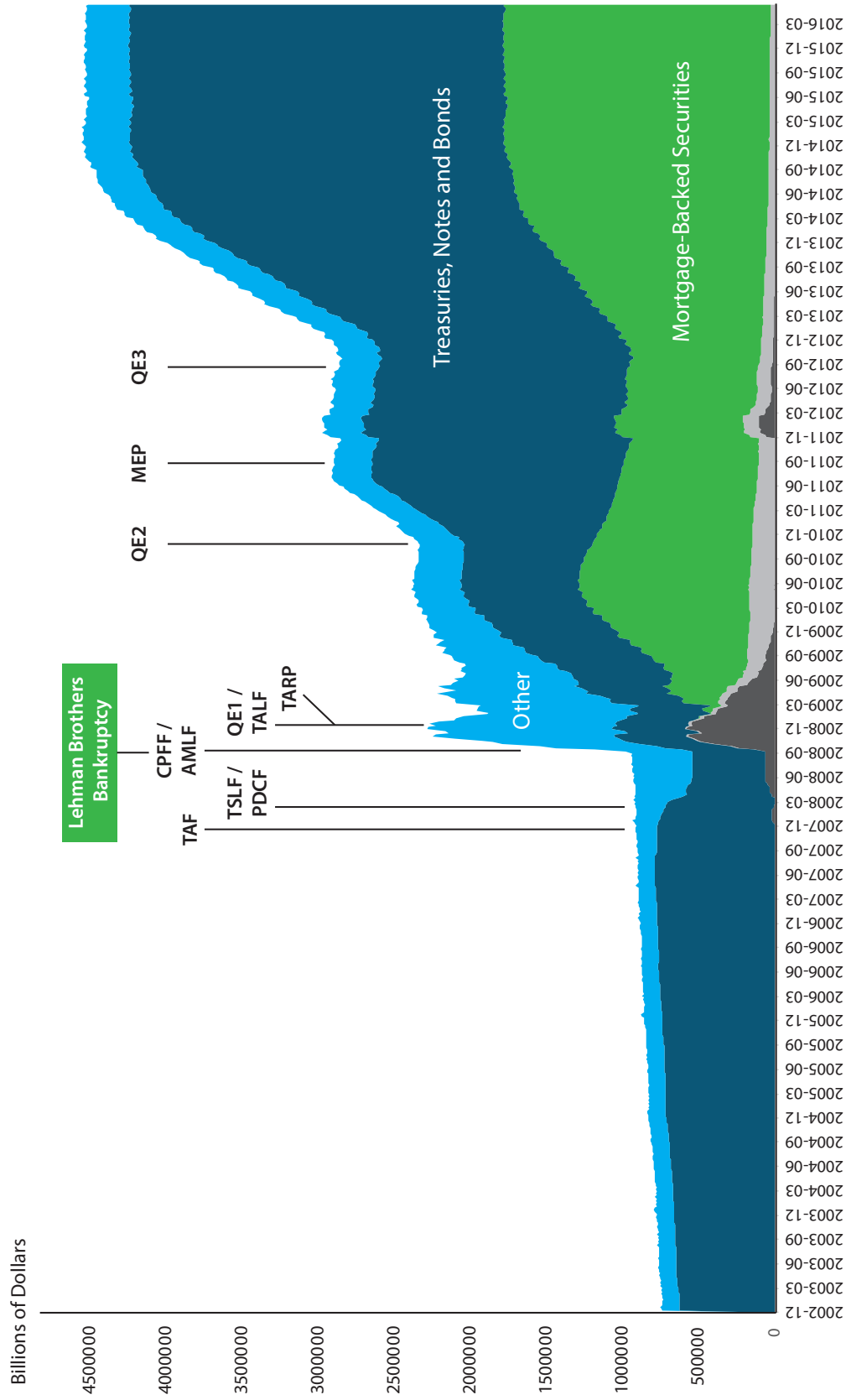
In the immediate aftermath of the collapse, the Fed created the Asset-Backed Commercial Paper (ABCP) Money Market Mutual Fund Liquidity Facility (AMLF), which was guaranteed by the Treasury (Fawley and Neely, 2013). The amelioration in short-term funding markets, especially that of commercial paper, was not realised. The Reserve Primary Fund, a large money market fund, had heavy investment exposure to Lehman Brothers, with the default causing its net asset value to drop below \$1, which is referred to as 'breaking the buck'. As a result, there was a flight to quality, from high-yielding prime money market funds toward those that held Treasuries (safe government securities) only (Adrian et al., 2011). In an effort to avoid a bank run in money markets, the Fed established the Commercial Paper Funding Facility (CPFF), purchasing high-quality commercial paper (Fawley and Neely, 2013).

The failure of commercial paper funding translates into increased difficulties in meeting the credit needs of businesses and households, for institutions outside of the Fed's discount window. This liquidity facility extended the discount window to all issuers of commercial paper. Liquidity facilities like these provide backstop funding in dysfunctional markets. Increased liquidity, through the so-called liquidity channel, provides assurance to both the issuer of the commercial paper and the investor that short-term debt obligations will be met, but does not guarantee the solvency of firms (Adrian et al., 2011).

The establishment of these facilities entailed an increase in the size as well as a change in composition of the balance sheet of the central bank, and could have had potential fiscal consequences⁶⁷. Creating these types of facilities was the first among many steps by the Fed that moved it out of the territory of conventional easing, as it entailed the purchase of assets that could expose the central bank to credit risk. In other words, these actions heralded the start of credit policy in the US, with the intention of targeting specific market segments in purchasing private sector assets (Bernanke, 2009). In addition, these were also the first unsterilised purchases, indicating an extraordinary expansion of the balance sheet (Fawley and Neely, 2013)

⁶⁷Concerns were raised over the fiscal independence of the central bank.

Figure 6: Assets on the balance sheet of the Fed



Source: St Louis Federal Reserve Bank

7.1.2 QE1

After allowing Lehman Brothers to fail, the Fed realised that other large investment banks were credit constrained and afforded them the opportunity to borrow at the discount window, giving them a direct credit line to the central bank (Bernanke, 2009). However, the credit extended through various liquidity facilities and the extension of lender-of-last-resort services to a wider range of counterparties was not enough to turn the tide (Fawley and Neely, 2013). Even after establishing liquidity facilities in order to combat rapidly deteriorating conditions in short-term funding markets, the Federal Reserve could not independently reverse the fortune of financial markets, and as a recourse it solicited fiscal cooperation. In other words, the Fed was pressed to coordinate its efforts with the Treasury. In early October Congress passed the Emergency Economic Stabilisation Act, which established the Troubled Asset Relief Program (TARP) to the value of \$700 billion, in aid of financial stabilisation (Bernanke, 2009). The objective of this stimulus was to clear toxic assets from the balance sheets of financial institutions, in order to avoid over-leveraging and potential fire sales.

Having reduced the federal funds rate close to the zero lower bound (0.25 %), the Federal Reserve believed that to further stimulate economic activity, it would have to utilise another tool in its policy arsenal, namely unsterilised purchases of government sponsored enterprise (GSE) debt and mortgage-backed securities (MBS) to the total of \$600 billion (Gagnon et al., 2011). This first round of quantitative easing or large-scale asset purchases (LSAPs), referred to as QE1, was implemented on the 25th of November 2008. In addition to this initial purchase, in March 2009 the Fed increased QE1 purchases, which consisted mostly of GSE debt (\$100 billion), MBS (\$750 billion) and long-term Treasury bonds (\$300 billion). The total assets purchased in QE1 cumulated to a value of more than \$1.75 trillion (Fawley and Neely, 2013).

The housing market and related institutions were the primary target of these policy actions, with more than 80% of total purchases being related to the housing credit market (Fawley and Neely, 2013). In terms of the transmission channel, the Fed was looking towards the portfolio balance channel to reduce term premia on long-term assets, a channel that was explicitly mentioned by Bernanke (2009). It utilised both credit policy (GSE and MBS) and quasi-debt management (long-term securities) to achieve this goal. Importantly, even though the quantity of bank reserves increased in these operations, they did not constitute 'pure' quantitative easing, as it wasn't the explicit target of the central bank (Borio and Disyatat, 2010)⁶⁸. The last part of this section contains a discusses on the empirical evidence of the efficacy of the different programs employed.

⁶⁸This point was emphasised by Bernanke (2009) who refers to QE along the lines of credit than quantitative easing.

7.1.2.1 TALF At the same time that QE1 was implemented, the central bank created the Term Asset-Backed Securities Loan Facility (TALF), which is a loan program that entices investors to purchase AAA-rated commercial MBS. This facility was the last in the line of the Fed's special liquidity facilities (Sack, 2010). It differed from most of the other liquidity facilities⁶⁹ in that it looked to provide support for market-based credit intermediation, rather than providing liquidity to commercial banks. It was specifically aimed at reviving securitised credit markets, opening up securitisation channels and thereby improving the "availability and affordability of credit for households and small businesses" (Bernanke, 2009). Two features that were unique to this facility were that TALF loans were non-recourse⁷⁰ and of longer maturities (Sack, 2010). In addition, TALF was available to a wide array of counterparties, thereby increasing the reach of the program.

7.1.3 QE2

Financial market turmoil subsided toward the latter part of 2010, with asset prices rising and private sector balance sheets being bolstered (Edmonds et al., 2010). However, despite the magnitude of expansionary fiscal and monetary policy, unemployment remained persistently high and disinflation continued unabated (Yellen, 2014). As emphasised by policymakers, the stagnating economic situation warranted a second round of easing in November 2010, to improve economic performance and quell some deflationary concerns (Fawley and Neely, 2013).

The second round of quantitative easing was different from the first in that the Fed looked only to purchase \$600 billion in long-term Treasury debt, with purchases occurring in monthly instalments of \$75 billion. In other words, the central bank was following a quasi-debt management strategy, with the goal of working through the scarcity channel to influence long-term security yields (Borio and Disyatat, 2010). In particular, the Fed wanted to push up prices and thereby drive down yields on long-term Treasury bonds, which in theory, would work to increase inflation expectations (Yellen, 2014). In addition, policymakers committed to keeping the federal funds rate close to the ZLB, enacting a forward guidance strategy.

7.1.3.1 Operation Twist In September 2011 there were concerns that a double-dip recession was looming, with growth still slow and signs of distress in global financial markets. Amelioration called for another round of easing but, instead of further outright purchases of

⁶⁹It differs in structure from the TAF, TSLF, PDCF and AMLF, but shares some similarities with the CPFF.

⁷⁰Collateral can be provided to the Fed; they do not have to repay the loan if the value of the collateral falls.

securities, the central bank experimented with maturity transformations similar to those of Operation Twist in 1961. On 21 September, in what was officially called the Maturity Extension Program and Reinvestment Policy, the Fed sold \$400 billion in short-term securities with a matching purchase of long-term securities (Fawley and Neely, 2013). With this policy the central bank attempted to ‘twist’ the yield curve, by reducing long-term rates relative to short-term ones.

The implementation of this quasi-debt management strategy was different than before in that it took place without expansion of the monetary base, entailing only a change in composition of the assets on the balance sheet. In other words, the revived Operation Twist differs from QE2 in that liabilities (reserves) increased with the purchase of long-term assets during QE2, while there was no increase in liabilities in the MEP, but rather a change in the type of assets held by the central bank (Fawley and Neely, 2013). Operation Twist was extended in June 2012 with another \$267 billion worth of long-term government securities purchased to “make broader financial conditions more accommodative”⁷¹.

7.1.4 QE3

Policy efforts to reduce persistently high unemployment rates were considered partially successful. However, the labour market remained sluggish,⁷² featuring a significant unemployment gap. The third round of quantitative easing was aimed directly at improving economic conditions, with a specific focus on reinvigorating the labour market (Fawley and Neely, 2013). Purchases of MBS were made on a monthly basis, to the tune of \$40 billion. In addition, the central bank reinvested principal payments of MBS, which accounted for another \$45 billion dollar monthly injection into long-term treasury securities. This translated into an increase in holdings amounting to \$85 billion per month (Yellen, 2013). This initiative is similar to QE1 in the variety of assets purchased, but distinctly different with regard to the communication of assets purchased (Fischer, 2015a).

QE3 entailed a more open-ended structure, citing no total amount of assets that would be purchased, but rather a commitment to continue purchasing assets at regular intervals until labour market conditions improved. At first, the condition for exiting this commitment was vague, with the FOMC relaying a scenario in which there was “significant improvement” in labour market conditions (Yellen, 2015). At a later stage, it was announced that the pace at

⁷¹Quoted from the Federal Reserve Press Release on the 20th of June 2012.

⁷²The housing market was also depressed during this period, but the focus of QE3 was on improvements in the labour market position.

which purchases were to be conducted would be data dependent; in particular, they were looking toward conducting purchases until the unemployment rate went below a certain threshold (in this case it was 6.5%)⁷³.

7.1.4.1 Tapering On 22 May 2013, Ben Bernanke revealed that the pace of asset purchases might start slowing before the end of the year if labour market conditions continued to improve. It was projected that a reduction in the unemployment rate below the suggested threshold would possibly be achieved in 2014. Shortly after Bernanke's statement, financial markets reeled at the thought of a potential taper. Further distortions in economic conditions were felt outside the borders of the US, specifically in developing countries, with large capital outflows emanating from these countries⁷⁴.

Taking note of the strong adverse reaction to the tapering announcement, the Fed made it clear on 18 September 2013 that it did not have any immediate plans to reduce the asset purchase programs. This alleviated some of the pressure following the initial suggestion of winding down QE3, with emerging markets enjoying the greatest relief (Kumar and Barua, 2013). The eventual start of the taper took place on 18 December 2013, with purchases down from \$85 to \$75 billion dollars a month. At this time, the Federal Reserve Open Market Committee (FOMC) also announced that QE3 would be tapered at a suggested rate of \$10 billion at each successive meeting, outlining a complete winding down of the purchasing program by October 2014.

7.1.5 Normalising Monetary Policy

Since the start of the financial crisis, the central bank accumulated a large portfolio of long-term securities⁷⁵, with the federal funds rate being close to the ZLB for more than six years (Yellen, 2015). At the start of 2015, with the US economy showing signs of recovery, questions as to the normalisation of monetary policy and a potential increase of the short-term policy rate came to the fore. As discussed previously, if policy is too accommodative for too long, it could create an environment where excessive risk-taking takes hold. Some interest rate rules that take both unemployment and output gaps into account had already necessitated increases in the policy rate. However, the reading of these rules depends on the definitions of historical inflation and natural rates of employment (Yellen, 2015). The experience of Japan has taught policymakers not to be too hasty in coming out from under the ZLB.

⁷³This target was announced at the FOMC.

⁷⁴This is an issue I discuss in the concluding section of the thesis.

⁷⁵Current assets are at \$4.5 trillion, up from \$900 billion before the crisis.

The “conditions for liftoff”, as Stanley Fischer (2015b) puts it, are sufficient improvements in the labour market⁷⁶ and confidence in the fact that inflation will move to the 2% objective in the medium term. In December 2015 the Fed increased the federal funds rate by 25 basis points, which marked the first increase in the policy rate in a seven-year period where it was kept near the ZLB (Yellen, 2016). One of the newfound challenges faced by the central bank is conducting monetary policy with an elevated balance sheet. Owing to the size of the balance sheet⁷⁷, traditional repurchase agreements will fall by the wayside and normalised monetary policy will entail setting of the interest on excess reserves (a mechanism discussed in both Section 4 and 5).

In addition to the interest on excess reserves, the Fed will also be conducting overnight reverse repurchase agreements, with a wide range of eligible counterparties⁷⁸. This overnight facility will create a soft floor on money market rates. These issues will be discussed in more detail in the last part of Section 4, where I consider the possible drawbacks of implementing balance sheet policies. In the next section I look at the policy response of the ECB to the financial crisis.

7.2 EU: European Central Bank

7.2.1 The European Banking System

In order to appreciate fully the policy response of the European Central Bank (ECB), it is necessary to set the stage as to the position of Euro area banks before the crisis, as their structure differs in significant ways from the US economy. Several systemic balance sheet vulnerabilities were present in the EU before the crisis. European banks have increasingly developed a reliance on wholesale funding, but not to the extent of the US (Pill and Reichlin, 2014). In the years leading up to the crisis, approximately 30% of external funding for firms originated from financial markets in the EU, while in the US this figure was closer to 70% (Trichet, 2009; Cour-Thimann and Winkler, 2012). Naturally, the development of other sources of external credit meant that the ratio of loans to traditional deposits started to decline (Giannone et al., 2012).

In addition to an increased dependence on external market-based funding, banks started to use newly developed financial instruments and processes. In particular, European banks started

⁷⁶To the point where full employment is reached, as stated by Yellen (2015).

⁷⁷With more than \$3 trillion in excess reserves.

⁷⁸At this point it includes money market funds, depository institutions, broker dealers and government sponsored enterprises (Fischer, 2015a).

to use off-balance-sheet vehicles, securitisation and several structured financial products (Pill and Reichlin, 2014). Several European bank balance sheets were also contaminated with asset-backed securities that originated in the US, but fortunately exposure was limited. Despite all these concerns, the structure of the European economy was still largely bank-based (Cour-Thimann and Winkler, 2012). In fact, it was postulated by Padoa-Schioppa (2004), before the crisis, that the Eurosystem would be able to survive a run on secondary markets, as its funding originated mostly from primary markets.

Outside of the exposure to flighty assets, the EU had its own unique problems to deal with. Importantly, the cross-border exposure of banks to wholesale funding had increased significantly since the inception of the monetary union. Supervision at the national level meant that retail markets remained segmented, but cross-border funding markets became more active, with increased financial integration (Pill and Reichlin, 2014). In particular, larger economies with slow and steady growth found opportunities to finance the demand for credit in smaller developing nations (González-Páramo, 2011). Unfortunately, this meant that imbalances on the current and financial accounts of many Euro area countries were exacerbated; this was a large contributor to the sovereign debt crisis.

Successful financial integration resulted in a narrowing of spreads in the sovereign bond market⁷⁹, which would usually be indicative of a decrease in the market's pricing of sovereign risk (Ehrmann et al., 2010). However, it is thought that the compression of the spread could have been due to the involvement of the ECB, with their mandate providing an inherent guarantee against the failure of a sovereign entity (which further promoted risk-taking and moral hazard) (Pill and Reichlin, 2014). Taking this structure into consideration, I provide an overview of the traditional format of monetary policy implementation and the manner in which the central bank amended its approach to address mounting concerns.

7.2.2 Monetary Policy Implementation at the ECB

In contrast to the fixed-rate open market operations of the Fed, monetary policy at the ECB is usually conducted through refinancing operations in an auctioning process. In this setup the ECB sets a liquidity cap, and the lowest bids are accepted, which is referred to as the variable-rate tender procedure (Cour-Thimann and Winkler, 2012). In June 2000 the ECB switched from fixed- to variable-rate tenders, in response to overbidding in the fixed-rate system⁸⁰ (Catalão-Lopes, 2010).

⁷⁹At one point before the crisis the spreads were what Cour-Thimann and Winkler (2012) refer to as, “quasi null” among the sovereigns of the Euro area.

⁸⁰This system was not with full allotment.

In general, the ECB offers two types of collateralised lending options, differentiated by maturity. Main refinancing operations (MROs) are the primary mode of policy conduct; they have a maturity of one week and are auctioned weekly. More recently, the bank introduced the longer term refinancing operations (LTROs), which at first were presented with a maturity of three months; these are auctioned once a month (Vogel, 2016)⁸¹. In the months before the collapse of Lehman Brothers, the ECB tried to address building pressure by introducing reductions in the MRO interest rate⁸². It became evident that policy rate cuts were not going to provide the necessary stimulus in constrained credit markets, which prompted the ECB to implement several liquidity management measures⁸³. These measures formed part of the first phase of the policy response of the ECB, namely the Enhanced Credit Support program, which is discussed subsequently.

In terms of the ECB policy response to the crisis and the surrounding fallout, four phases are identified⁸⁴. First, liquidity management operations started as early as 13 months before the collapse of Lehman Brothers, in September 2008. The demise of this institution heralded the start of the global financial crisis and heightened the intensity of management required, which involved several alterations and additions. This approach is referred to by Trichet (2009) as enhanced credit support (ECS). Second, an equally important event for the Euro area is the sovereign debt crisis that started in May 2010, specifically as a result of developments in the Greek economy. This phase also included the resurgence of the debt crisis, with several other member states experiencing similar difficulties to that of Greece, in June of 2011. Third, the current ECB president, Mario Draghi, famously stated that the ECB was committed to do “whatever it takes” to salvage the Euro. Finally, the last phase is considered the one in which quantitative easing measures were adopted, in January of 2015.

7.2.3 Phase 1: Enhanced Credit Support

Financial distress in the Eurozone following the Lehman Brothers episode was exhibited in the widening of several interest rate spreads, such as the Eurbor-OIS spread⁸⁵ (Fawley and

⁸¹Practically, the ECB also uses fine-tuning operations (FTOs) with the objective of steering interest rates toward the policy rate target.

⁸²They also varied the interest rate corridor, initially decreasing it from 200 basis points to 100 basis points.

⁸³They correspond with the label of exceptional liquidity provision as classified in the typology of unconventional policies by Szczerbowicz (2015). Unconventional policies here fall under the banner of either exceptional liquidity provision or asset purchases. In the typology of Borio and Disyatat (2010), exceptional liquidity provision is classified under credit policy.

⁸⁴These coincide somewhat with those identified in Cour-Thimann and Winkler (2012) and Pill and Reichlin (2014).

⁸⁵Spread between a secured (Eurbor) and unsecured (OIS) money market rate. Indicates the premium that agents are willing to pay for security; a safety premium.

Neely, 2013). The widening of spreads was indicative of the increased counterparty risk, emanating from the uncertainty with respect to the health of the balance sheets of financial institutions. The interbank market in the case of the ECB extends beyond several borders and therefore segmentation becomes an important issue. Counterparties in this setting may find it difficult to participate in the interbank market, based on the “perceived riskiness of their sovereign” (González-Páramo, 2011). Despite initial liquidity provisions, the volume of interbank lending remained lacklustre “because of mounting insolvency and liquidity risks exacerbated by asymmetric information” (Rodríguez and Carrasco, 2014).

In May 2009 the ECB formulated their actions with regard to liquidity management, in the form of the ECS program. The goal was to provide liquidity to the banking sector and remedy the lack of counterparty confidence. As mentioned before, the banking sector was becoming more reliant on wholesale funding. However, the ratio of loans to traditional deposits (leveraging) had not reached the level of the US, with the traditional banking sector still playing an important role in the extension of credit. Therefore, to address dysfunctional markets, the ECB opted to target the banking sector aggressively with the ECS program. According to Trichet (2009), “enhanced credit support constitutes the special and primarily bank-based measures that are being taken to enhance the flow of credit above and beyond what could be achieved through policy interest rate reductions alone”.

7.2.3.1 Five cornerstones Jean-Claude Trichet, who was president of the ECB at the time, identified five policy cornerstones of the ECS program (Trichet, 2009). First, in early 2008 the ECB introduced the Fixed Rate Procedure with Full Allotment (FRFA) program. The FRFA gave commercial banks access to unlimited amounts of liquidity against eligible collateral at the main refinancing rate, provided they were financially sound (González-Páramo, 2011). This often-overlooked policy shift is considered by several ECB central bankers⁸⁶ to be the most significant liquidity management operation conducted to retain the health of the financial sector. Liquidity risk generated by elevated lending rates in interbank markets posed a threat to many financial institutions. Liquidity provision under this strategy aimed to facilitate interbank lending and, by extension, increase the availability of credit to households and firms (Falagiarda et al., 2015).

Lorenzo Bini Smaghi⁸⁷ refers to the FRFA as “endogenous credit easing”, in that banks can meet all their liquidity needs, with peak demand before the crisis reaching €95 billion (Rodríguez and Carrasco, 2014). In this setup the ECB sets the MRO refinancing rate, and interbank market

⁸⁶Such as Trichet (2009) and González-Páramo (2011)

⁸⁷Member of the Executive Board of the ECB from 2005 until 2011.

rates are variable (determined by supply and demand) (Catalão-Lopes, 2010). Fluctuations in the quantity demanded reflects market sentiment, with high liquidity demand indicative of the strain in interbank lending⁸⁸. In addition to the mere provision of liquidity, this mechanism works by providing liquidity more cheaply than the market price; which in turn drives down money market rates (González-Páramo, 2011). Immediately following the collapse, banks began to overbid in terms of price of the MROs, in an attempt to secure liquidity. Overbidding pressure prompted the ECB to discontinue traditional refinancing operations of all maturities (MROs and LTROs) and replace them with fixed-rate tenders (Szczerbowicz, 2015). However, this resulted in severe overbidding on the amount of liquidity, as there was no associated penalty⁸⁹.

Second, in addition to the FRFA, supplementary LTROs with a six-month maturity were instituted before the crisis, with the first round met with a fourfold oversubscription of bids, and €442 billion was eventually supplied (Trichet, 2009; Darracq-Paries and De Santis, 2015). In June 2009 12-month LTROs were created to cater for commercial bank preferences for assets of longer maturities (Fawley and Neely, 2013)⁹⁰. This can help address maturity mismatches where banks are looking for investments in longer-term bonds, but only finding funding in the shortest end of the market. It reduces the uncertainty involved in laying out investment strategies. Policy is designed with the expectation that banks will use long-term credit to fund long-term asset investment, rather than supply short-term liquidity.

Third, the list of assets eligible for collateral was extended by lowering the ratings threshold. Allowing a wider range of collateral affords banks the opportunity to refinance a larger portion of their balance sheet ⁹¹ (Cour-Thimann and Winkler, 2012). Previously illiquid assets can now be transformed, potentially preventing liquidity shortages in secondary markets. In addition to the type of collateral, there is an increase in the number of counterparties that can take part in the refinancing operations (Trichet, 2009). Fourth, international swap lines allow financial institutions to address foreign currency funding (Falagiarda et al., 2015). Cooperation among central banks is key in this respect.

Finally, the Covered Bond Purchase Program (CBPP) was created, with these purchases being the ECB's first foray into asset purchases (Falagiarda et al., 2015). The first round of covered bond purchases, called CBPP1, amounted to €60 billion and took place between July 2009 and July 2010. A supplementary round of purchases, CBPP2, took place between November 2011 and October 2012. However, the number purchased was almost negligible during this

⁸⁸Which would also show in interest rate spreads, with the spread between secure/unsecure assets widening.

⁸⁹Importantly, some of the excess liquidity went into Eurozone debt securities, which exacerbated the problems presented in the debt crisis. This overbidding was also the reason why the ECB initially switched to variable rate tenders in 2000.

⁹⁰The first auction closes with more than 1000 bidders, indicating increasing demand for LTROs

⁹¹In July 2009 eligible securities totalled €12.2 trillion.

round, amounting to less than €17 billion in total (González-Páramo, 2011). Trichet (2009) states clearly that covered bond purchases were not considered quantitative easing, as they would not result in an expansion of the ECB's balance sheet. He believed that there would be an "automatic sterilisation", with a simultaneous reduction in purchases of LTROs. However, according to the data, the balance sheet of the bank did not remain unaltered, and expanded by 30% in the most acute phase of the crisis, which indicates that sterilisation was not complete (Rodríguez and Carrasco, 2014).

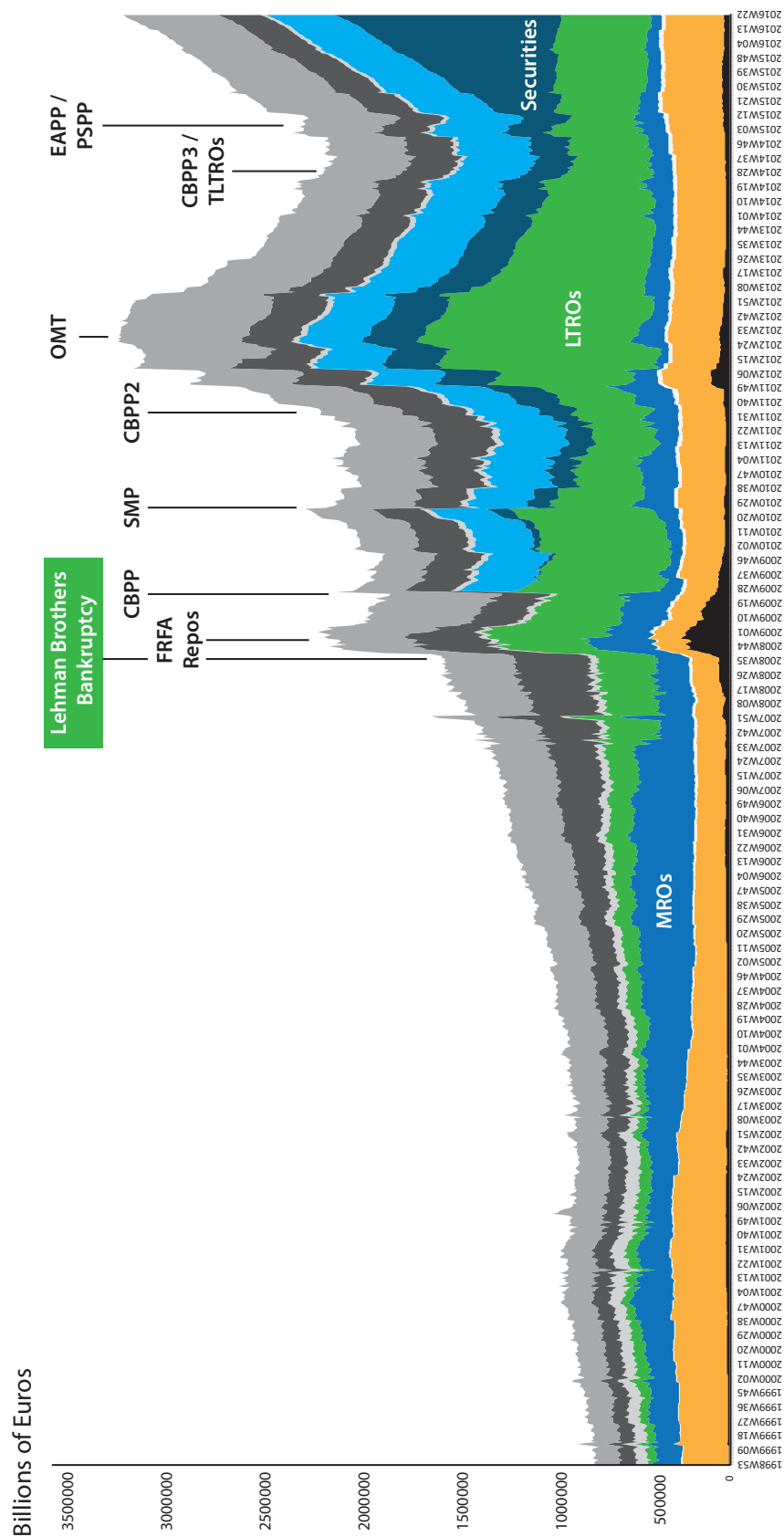
In comparison with the Fed, the ECB was a latecomer to the asset purchase party, as QE1 was already well under way during this time. This was because the US had to respond more swiftly, as financial institutions were exposed directly to mortgage markets: they had greater flexibility in the economy⁹², and the funding structure revolved around money markets for funding, as opposed to the more traditional banking sector (Trichet, 2009). The reason for implementing CBPP hinged on two factors. First, it allowed the opportunity to address maturity mismatches between assets and liabilities (Trichet, 2009). Second, covered bonds markets are important and these securities are different from most asset-backed securities in several ways. They are a form of recourse debt, whereby the bond holders can collect from the issuer of the bond and are entitled to the underlying collateral pool. In addition, underlying collateral is held on the consolidated balance sheet of the bond issuer, similar in spirit to originate-and-hold mortgages in the US (Fawley and Neely, 2013).

7.2.4 Phase 2: Sovereign Debt Crisis

In October 2009 it was revealed that Greece had been misreporting statistics with respect to their debt. This deception meant that interbank lending to Greek banks dried up, which raised concerns over Greek solvency (Pill and Reichlin, 2014). Uncertainty surrounding the fiscal position of the country translated into a sharp decline in the demand for Greek government bonds and, as a result, sovereign spreads widened against several countries in the Eurosystem. The possibility of sovereign debt default was on the cards as the economy struggled to find funding to meet debt payments. This was problematic for the ECB, as default would have meant an exit from the Euro area, which in turn could have spread to other countries in a similar fiscal position, such as Ireland, Portugal, Spain and Italy (Cour-Thimann and Winkler, 2012). In addition, the portfolios of several countries, such as Germany and France, were heavily exposed to Greek debt.

⁹²The labour market in particular is more responsive in the US.

Figure 7: Assets on the balance sheet of the ECB



Source: European Central Bank

This sovereign debt crisis spurred a fire-sale on several Euro area government bonds. In order to contain the crisis and avoid financial contagion, several emergency facilities were created. The adjustment program consisted of bilateral loans from Eurosystem countries (European Commission) and support from the International Monetary Fund (IMF)⁹³ (Pill and Reichlin, 2014). Despite these attempts to boost sovereign solvency, interest in Greek debt remained stale. In the face of mounting pressure, the ECB was forced to act⁹⁴ and provided ancillary support through the creation of the Securities Markets Programme (SMP), injecting liquidity into dysfunctional markets through the purchase of sovereign bonds in secondary markets⁹⁵ (Szczerbowicz, 2015). SMP is considered a sterilised purchase program⁹⁶ and did not expand the balance sheet of the bank, which classifies it as credit policy (Fawley and Neely, 2013). Communication under this purchase program was limited, with no details on the bonds purchased, counterparties or length of the scheme made available to the public (Szczerbowicz, 2015).

The ECB justified the SMP on the grounds that it would restore the functioning of the monetary policy transmission mechanism and relieve tension in sovereign debt markets (Falagiarda et al., 2015). In practice, they were preventing a Greek default, by aggressively removing debt from the market. More importantly, the ECB brokered debt restructuring for private debt holders (Pill and Reichlin, 2014). However, this was a symptomatic treatment and public finance remained a topic for concern throughout the Eurosystem. Contagion had spread to Ireland in 2010 and Portugal in 2011, which meant that the ECB had to step in as a lender-of-last-resort for these sovereigns. Within the SMP, the ECB spent a total of €219.5 billion on Euro zone government bonds, but this was not spent according to paid-in capital; rather, it focused only on vulnerable countries, and thereby, spread the risk (Szczerbowicz, 2015). Shortly after the effective bailout of Greece, Ireland and Portugal, there was a discussion as to the fiscal health of the Italian and Spanish economies. The ECB had enough funds at its disposal to assist some of the smaller member states, but the default of large countries like Italy and Spain would have been far beyond the reach of the monetary authority.

7.2.5 Phase 3: ‘Whatever it Takes’

At the start of the financial crisis, the ECB highlighted the fact that nonstandard policies were temporary, only to be used as long as they were considered necessary. However, by late 2011

⁹³This was later formalised in the form of the European Financial Stability Facility (EFSF) and European Stability Mechanism (ESM).

⁹⁴The European Commission, IMF and ECB form part of what is referred to as the “troika”, three institutions that aided in preventing default in the Eurozone.

⁹⁵The ECB is prohibited from purchasing sovereign debt in primary markets through Treaty provisions.

⁹⁶Purchases were sterilised through ‘Fixed Term Deposits’ (Rodríguez and Carrasco, 2014).

fears of a sovereign debt crisis were reignited, as the solvency of Italy and Spain was considered. Sovereign bond prices plummeted and significantly altered the balance sheet positions of several banks in the Euro area (Cour-Thimann and Winkler, 2012). The widening of sovereign yield spreads reflected the fact that market participants believed economies could potentially be leaving the monetary union. In order to preserve the union, unconventional policies became a more permanent fixture in the ECB's policy toolkit (Falagiarda et al., 2015). Mario Draghi's (current president of the ECB) first response was to reinstate the SMP, which had been dormant since the bailout of Portugal in early 2011 (Pill and Reichlin, 2014). In addition, he announced the creation of 36-month LTROs, as well as the second round of covered bond purchases (as mentioned before) (Cour-Thimann and Winkler, 2012). The LTROs were specifically aimed at sovereign debt, providing liquidity over the medium term.

Talks arose about the exit of certain countries from the monetary union and the ensuing reversibility of the Euro. In response, in July 2012, Draghi famously stated that the central bank would do "whatever it takes to save the Euro". The ECB followed through on the commitment with the announcement of the Outright Money Transactions program in September 2012 (Pill and Reichlin, 2014). Under this scheme, which officially replaced the SMP, the ECB agreed to intervene in secondary sovereign bond markets if this became necessary.

The OMT differed from the SMP in several ways. First, an important improvement on the SMP was that purchases of sovereign debt in the secondary market⁹⁷ would be conditional, with the ECB buying debt only once countries had accepted and met the conditions for structural and fiscal reform set by the European Commission, ECB and IMF (often referred to as the "Troika") (Fawley and Neely, 2013). Second, the ECB was more transparent about communicating its purchase strategies and there would be no "ex ante quantitative limits" on the purchases once conditions had been met (Cour-Thimann and Winkler, 2012). Third, the focus of the OMT was on shorter-term bonds, whereas the SMP focused on longer-term securities (Szczerbowicz, 2015).

Similar to the function of the SMP, the OMT was established to improve the functioning of the monetary policy transmission mechanism. The OMT is considered to be credit policy, with purchases sterilised similarly to those of the SMP. Interestingly, the OMT has, to date, not been used. However, it was considered successful in that it acted as an insurance mechanism against redenomination risk, signalling the commitment of the bank to prevent the exit of struggling member states (Pill and Reichlin, 2014). In fact, the mere announcement of the OMT reduced risk premia and brought sovereign spreads closer to one another (Szczerbowicz, 2015).

⁹⁷The ECB is prohibited from purchasing debt directly from governments, and needs to purchase debt from investors.

Focusing more on communication with the general public seems to be part of a new strategy employed by the ECB.

7.2.6 Phase 4: A New Framework

Deflationary pressure became of particular concern with the steady decline of inflation since the start of 2012. The ECB, under the guidance of Mario Draghi, developed a multifaceted strategy to boost economic growth in what can be considered a new framework⁹⁸. This framework is similar to that implemented in other central banks and combines forward guidance with credit and quantitative easing. Forward guidance, which forms an important part of this new framework, made its first appearance in July 2013, when the ECB made it clear that rates were going to remain low for an extended period of time (Falagiarda et al., 2015). By May 2014 the deposit rate, the lower bound on the policy rate, had dipped below the ZLB, and interbank rates followed suit. However, even negative rates failed to reignite interbank activity and spur economic growth (Valiante, 2015). In response, the ECB unveiled its credit easing package in June 2014, which was mostly an extension of measures implemented in the ECS program. The package consisted of targeted LTROs, an Asset Backed Security Purchase Program (ABSPP) and another round of covered bond purchases, CBPP3 (Falagiarda et al., 2015).

Targeted LTROs are a new loan facility that is intended to encourage banks to extend credit to the private sector by reducing financing costs (Blot et al., 2015). These 48-month TLTROs are supposed to provide banks access to a source of low-interest-rate funding for the following four years. The ECB hoped that these would entice banks to lend to the real economy. They are specifically aimed at small to medium-sized nonfinancial firms (Szczerbowicz, 2015). They differ from previous LTROs in that the amount a bank can acquire is provisioned on the amount of loans extended to the nonfinancial private sector in the Euro area (Blot et al., 2015). However, these TLTROs did not have an immediate impact on the economy, which provided an incentive for the ECB to enact a more rapid-acting mechanism, namely a private asset purchase program.

ABS purchases and CBPP3 were meant to supplement the TLTROs. They were meant as a direct intervention in secondary bond markets, purchasing the securities of European firms and residential real estate loans to affect long-term bond yields. At this point the asset purchases were still sterilised and limited to private sector debt. However, in 2015 the central bank announced an extension of the program, called the Extended Asset Purchase Programme (EAPP) that would signal the movement to quantitative easing. The ECB claimed that it was

⁹⁸Can be considered new in the sense that it moved outside its single mandate to focus on price stability. Now considers economic growth as well.

merely expanding an existing program of asset purchases, but under the EAPP, unsterilised purchases were added, moving from the passive management of liquidity demand to a more active intervention (Breuss, 2016).

In March 2015 the ECB announced, as part of the EAPP, the Public Sector Purchase Programme (PSPP), the first instance of QE in the Euro area. This program diverged from previous attempts in two distinct ways. First, it would start purchasing bonds issued by “Euro area central governments, agencies and the European institutions”, which meant intervention in primary markets for sovereign debt (Falagiarda et al., 2015). Second, the scale of the program was unprecedented, with liquidity provided by the ECB under the EAPP amounting to €50 billion a month⁹⁹, with a conditional commitment to keep it in place until inflation met the mandated medium-term objective (around 2%) (Breuss, 2016). This was estimated to be at the end of March 2017, with a total of €1500 billion bought in total. This program was met with significant resistance, as it was felt that it contradicts the conventions of the EU Treaty, blurring the line between fiscal and monetary policy. PSPPs were distributed according to paid-in capital, to avoid them being just a redistribution of risk between member states (Krampf, 2016). The next section looks at how balance sheet policies were implemented in the United Kingdom.

7.3 UK: Bank of England

Balance sheet policy implemented in the UK is not significantly different from that of the US. Policy comprised the creation of several liquidity insurance facilities and successive rounds of quantitative easing. The timeline of implementation of rescue efforts by the Bank of England (BoE) is also relatively in line with that of the Fed’s actions. Before introducing the measures used during the financial crisis, it is worth looking at how the BoE conducts monetary policy under normal circumstances, as it settled on a new monetary framework in the build-up to the crisis.

7.3.1 Sterling Monetary Framework

The BoE revised its operational framework for monetary policy in 2006. Management of the balance sheet was now coordinated under the Sterling Monetary Framework (SMF). This new system revolves around the use of reserves, standing facilities and open market operations. It

⁹⁹Of purchases, 88% are sovereign bonds, and 12% are the bonds of supra-national institutions.

has all the qualities of a reserve regime¹⁰⁰ whereby banks decide on how many reserves to hold, which means liquidity issue is demand determined (Cross et al., 2010).

In contrast with the single mandate of several other central banks in developed economies, the BoE has an explicit dual mandate, with two objectives specified under its new operating framework (Joyce et al., 2012a). The first of these is the pursuit and maintenance of the CPI inflation target in the medium run, which is set at 2%. In normal times this is achieved through setting the policy rate. Second, the BoE is tasked with reducing the cost of disruptions to the functioning of commercial banks, which is done through the provision of liquidity insurance (Cross et al., 2010). Taking into consideration the objectives of this framework, I consider the actions taken by the BoE to abide by its mandate.

7.3.2 Initial Response

The spill-over from the crisis significantly affected the UK economy, with real activity slowing and financial market mechanisms being broken. However, the pressure from failing financial markets was felt in the UK even before the Lehman Brothers bankruptcy. Northern Rock, a British bank, asked the BoE for liquidity support in September 2007. However, in February 2008 Northern Rock was nationalised in order to save it from a run on the bank¹⁰¹. At the height of the crisis, several large UK banks, such as Halifax Bank of Scotland (HBOS) and Royal Bank of Scotland (RBS), were found to be highly leveraged and dependent on wholesale funding. Large-scale intervention was required to save these struggling institutions, with HBOS getting acquired by Lloyds TSB with the aid of public capital. Lending conditions deteriorated, with solvency concerns about these large financial firms.

As a result of the evidence on policy implementation from the Japanese experience, the BoE reacted quickly to provide monetary policy support (Joyce and Woods, 2011). As a first line of defence, interest rates were radically reduced from 5.75% in July 2007 to 0.5% in March 2009¹⁰², as seen in Figure 5. In addition to interest rates cuts, several liquidity facilities were created and amended during this time. Similar to the liquidity facilities in other countries, those of the BoE were targeted at specific markets. In December 2007 the BoE announced a change to its existing three-month repo open market operations¹⁰³, with an extension on the range of

¹⁰⁰These monetary policy regime characteristics are defined in the second section of the thesis

¹⁰¹This is a situation under which depositors wish to withdraw their deposits. It could result from coordination failure, as in the Diamond and Dybvig result.

¹⁰²Which is effectively the ZLB for the bank

¹⁰³The BoE introduced longer-term repos (3, 6, 9 and 12 month) in 2006; similar in operation to the LTROs of the ECB

assets viable as collateral to include AAA-rated MBS and covered bonds (Cross et al., 2010). These newly formed longer-term open market operations (OMOs) were referred to as extended collateral long-term repos (ELTRs) and were initially offered at monthly auctions of £10 billion.

The BoE also formed two liquidity insurance schemes to provide liquidity to the banking sector, namely the Special Liquidity Scheme (SLS) and the Discount Window Facility (DWF). The SLS and DWF are off-balance-sheet collateral-swap initiatives that allow banks to swap high-quality illiquid securities (such as MBS) for UK treasury bills (Cross et al., 2010). Under these programmes the banks pay a fee according to the quality of the asset offered for the swap arrangement, in order to prevent opportunistic behaviour. Finally, as a result of tension arising in US markets, the BoE engaged in temporary foreign currency swap lines with the Fed, to meet dollar-denominated obligations.

7.3.3 Asset Purchase Facility

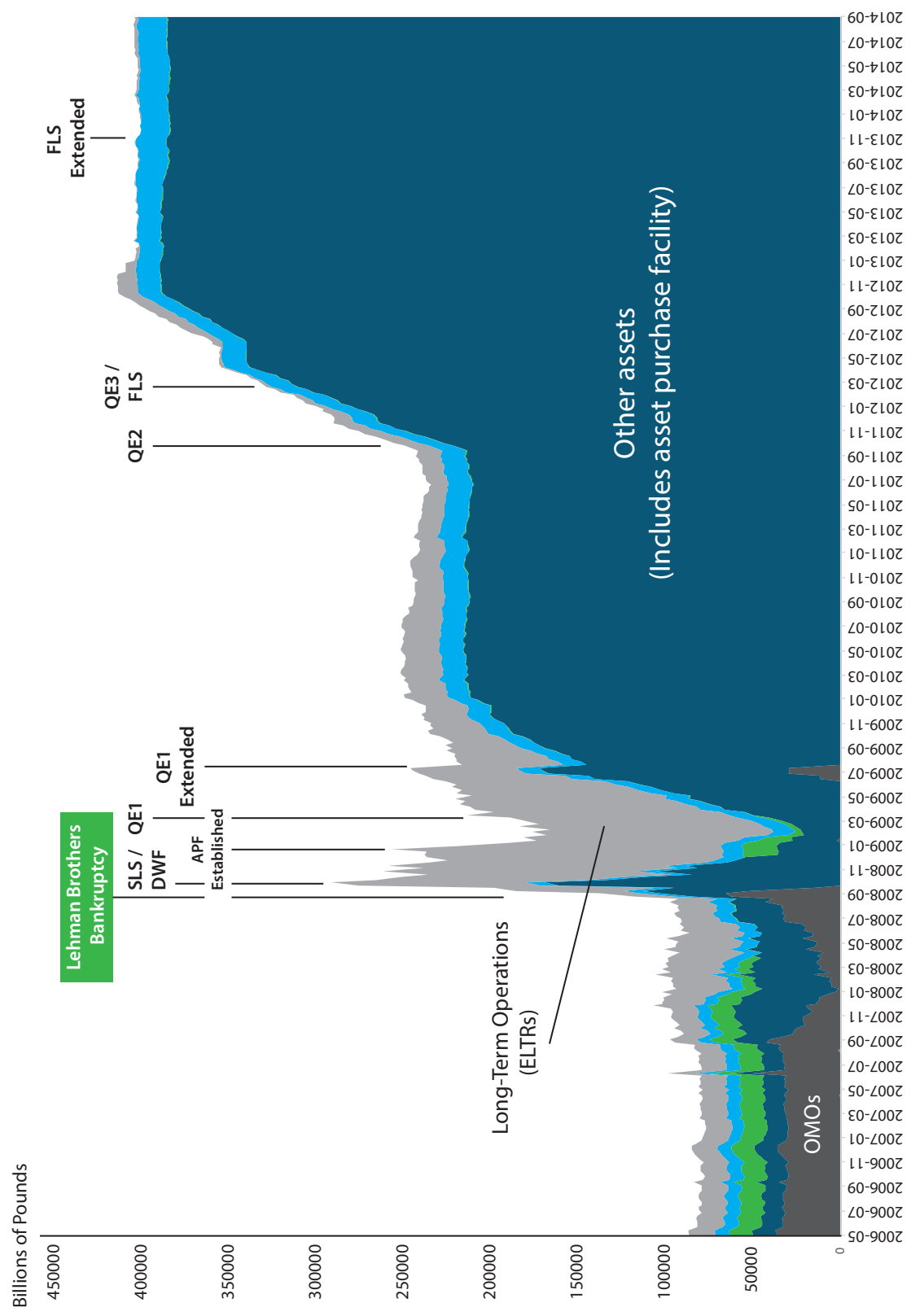
In January 2009 Her Majesty's (HM) Treasury announced the creation of the Asset Purchase Facility (APF). Operations were conducted through a limited company called the Asset Purchase Facility Fund (APFF), a legal entity that is fully under the control of the BoE (Joyce et al., 2012a). HM Treasury conducted both credit and quantitative easing through this fund. At first, the BoE was authorised to conduct purchases of up to £50 billion worth of high-quality private sector assets; however, private asset holdings reached a peak of only £3 billion. This credit easing was meant to increase the availability of corporate credit. Easing was justified on the grounds of the lender-of-last-resort function of the bank, as espoused by Bagehot. Purchases were sterilised¹⁰⁴ through sales of short-term gilts, which means this is a pure credit policy (Fawley and Neely, 2013). These liquidity provisions are considered similar to those conducted by the Fed under their CPFF program.

7.3.4 QE1

Despite aggressive easing the BoE felt that it would not be able to meet its mandated medium-term goal of 2% CPI inflation. The second operation under the APF was performed in March 2009 with the bank's explicit quantitative easing program to help achieve their policy objective. More specifically, the bank adopted a combination of bank reserves policy and quasi-debt management policy, increasing the size of the balance sheet through the purchase of £200

¹⁰⁴In other words, for every asset purchased, short-term gilts were sold to offset the increase in the size of the balance sheet.

Figure 8: Assets on the balance sheet of the BoE



Source: Bank of England

billion of assets¹⁰⁵ in the first round of easing. UK government bonds (gilts) of varying maturity (mostly from 5 to 25 years) formed the majority of the purchases (Steeley, 2015).

Quantitative easing as implemented by the BoE was intended as a liquidity injection to induce spending in the economy, in order to generate an inflationary effect (Joyce and Woods, 2011). Purchases¹⁰⁶ were financed by reserves, which translated into a fourfold increase in the monetary base from March to November 2009 (Cross et al., 2010). The backing by central bank money meant that this now was considered part of monetary policy. Since reserves in excess of voluntary targets were being issued, and the policy rate was near the ZLB, the SMP ceased its normal functioning. Policy was being conducted based on the size of the program, similar to that of Japan under QEP. Purchases continued until February 2010, when the MPC decided not to further increase the size of the balance sheet (Steeley, 2015).

At the same time as the first round of QE, the BoE implemented several changes to their ELTRs, with an increase in the amount available for auction, as well as inclusion of securities backed by mortgage assets and corporate bonds. These credit easing operations reached a peak of £180 billion in January 2009 (Cross et al., 2010).

7.3.5 QE2/3

Two years after the first round of QE the second round was started. In October 2011, the BoE conducted a further £75 billion worth of purchases. It was considered a necessary measure to keep inflation in line with its mandate. This increase occurred parallel to fears of a sovereign debt crisis in the Euro area. By May 2012 the second round came to an end, with a total of £125 billion purchased; bringing the total of QE to £325 billion (Steeley, 2015). The third round of QE quickly followed the second, due to a contraction of GDP between the last quarter of 2011 and the first quarter of 2012. Purchases under QE totalled £375 billion by July 2012 (Fawley and Neely, 2013).

In order to improve lending conditions the BoE and HM Treasury constructed the Funds for Lending Scheme (FLS). This scheme shares many similarities with the TLTRO program implemented by the ECB, and is thought to be the inspiration for that policy initiative. One of the differences between the FLS and TLTROs is that the BoE is able to coordinate its efforts with the Treasury in order to avoid significant losses, whereas the ECB has no single centralised Treasury (Steeley, 2015). Next, I look at the most recent monetary policy developments.

¹⁰⁵Initially set at £75 billion, but later expanded.

¹⁰⁶Loans to the fund.

7.3.6 Current Policy Stance

British monetary authorities have not had reason to implement large-scale changes to their balance sheet since QE3. Data from the first quarter of 2016 puts inflation at 0.5%, which is not close enough to the 2% target. However, the price level is expected to increase over the next year, as uncharacteristically low food and energy prices start to unwind. Economic growth has been positive, but modest. Forecasts by the BoE predict a slowdown toward the end of the year, in response to mounting pressure from the recent EU referendum result (Bank of England, 2016). In light of this evidence, the members of the MPC (May 2016) have voted to keep interest rates unchanged at 0.5% and the QE purchase limit at £375 billion (Emerson, 2016).

7.4 Japan: Bank of Japan

We have already covered the pre-crisis history of the BoJ's balance sheet policy. This section looks at the policy approach of the BoJ in the last decade, namely 2007 to 2016. The Japanese economy had just started to recover before the start of the crisis, but fortunately some of the policy tools had been tested before, so policymakers had some notion of how to approach macroeconomic shocks.

7.4.1 Japanese Banking System

The Japanese economy showed signs of recovery following its slump in the early part of the new millennium. In response, the BoJ started to unwind some of its unconventional measures, with quantitative easing coming to an end in 2006 (Kuttner, 2014). However, the financial crisis of 2008 resulted in a large negative shock, slowing economic growth significantly (Takahashi, 2013). Interestingly, the response of the BoJ in terms of financial markets was modest compared with other central banks, with unconventional policy not being adopted at first¹⁰⁷. The primary reason is that Japanese banks and financial firms were not heavily invested in US mortgages or structured financial products, such as credit default swaps. In other words, they did not have toxic assets on their balance sheets. This was due, in part, to reform in the banking sector following the banking crisis of the 1990s (Vollmer and Bebenroth, 2012). Japanese banks were focused on traditional banking activities, instead of the dissemination of securitised financial

¹⁰⁷In fact, the central bank has been criticised for the fact that it did not adopt aggressive unconventional measures in response to the unfolding of the crisis.

products. In addition, liabilities were mostly financed through the deposit base, with only 10% of financing derived from wholesale markets (Vollmer and Bebenroth, 2012).

Spreads on unsecured interbank markets remained relatively stable in the wake of the fall of Lehman Brothers, especially in comparison with other countries. The Tokyo interbank market rate (TIBOR), for example, showed little volatility. Transmission of the crisis was primarily through international capital movements, with the position on the capital, current and financial accounts deteriorating during this period (Vollmer and Bebenroth, 2012). This indicates that the crisis affected the economy through decreased exports, showing the reduced global demand and appreciation of the yen¹⁰⁸, rather than contagion in the financial markets (Takahashi, 2013). Capital outflows translated into a sharp decrease in the Nikkei stock index, translating into a decrease in the asset values of Japanese banks, which hold a substantial portion of their high-quality capital in stocks (Vollmer and Bebenroth, 2012). Despite the limited impact on the Japanese banking system, the economy experienced a sharp decline in growth, registering one of the greatest falls in GDP among OECD countries, as seen in Figure 4.

7.4.2 Initial Policy Response

The BoJ and the Financial Services Agency (FSA) started to react to the movements in the financial markets in September of 2008. In line with the path of other central banks, the BoJ implemented reductions to the prevailing policy rate in order to stimulate activity. In addition to the rate cuts, several measures were implemented to prevent further financial market distress. First, the BoJ agreed to swap lines with the Fed¹⁰⁹, in order to satisfy the increasing liquidity demand for US Dollars (Vollmer and Bebenroth, 2012). Second, in October 2008 the BoJ suspended the “sale of stocks purchased from financial institutions on the stock exchange”¹¹⁰. The motive for the suspension was to create space to monitor market developments. Third, changes were made to the securities lending facility. Usually, this facility allows repurchase agreements on JGBs, but in October 2008 the list of eligible collateral for repurchase operations was increased¹¹¹. This also heralded the return to JGB purchases, which last occurred in 2002 (Fawley and Neely, 2013).

Fourth, the BoJ showed interest in facilitating corporate financing, which was supported by the creation of a new credit facility called the “Special Funds-Supplying Operations to Facilitate

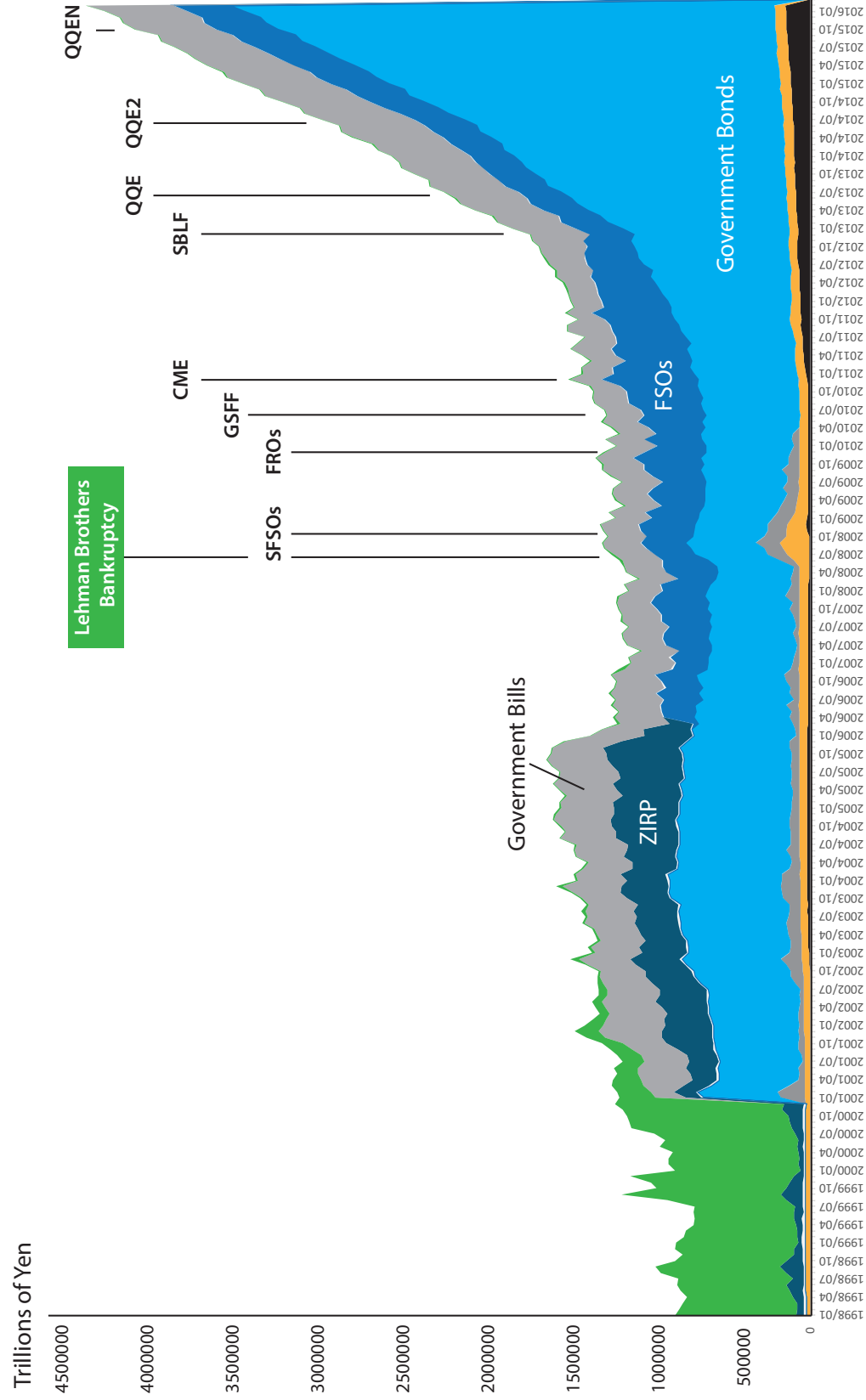
¹⁰⁸Appreciation of the yen occurred because the monetary base in Europe and the US was increasing at a faster rate than that of Japan. In addition, the yen was thought to be a less risky currency, as can be seen by looking at volatility indices, which meant a further appreciation in the currency (Takahashi, 2013).

¹⁰⁹Fixed-rate auctions were conducted, with full allotment.

¹¹⁰Taken from a statement released by the BoJ on the 14th of October 2008.

¹¹¹The list now included floating rate JGBs, inflation-indexed JGBs and longer term 30 year JGBs.

Figure 9: Assets on the balance sheet of the BoJ



Source: Bank of Japan

Corporate Financing”, which here will be called the SFSOs. Institutions are allowed unlimited 3-month loans at the uncollateralised call rate using this facility, which is similar to the FRFA of the ECB (Vollmer and Bebenroth, 2012). The facility involved an expansion of the balance sheet of the bank and constituted quantitative easing (Fawley and Neely, 2013). In addition to the loan provision of this facility, the BoJ announced temporary purchases of commercial paper and corporate bonds, a form of credit easing. The downside of these purchases was the exposure to credit risk. The initial response of the BoJ was a combination of the credit easing imposed by the US and the elastic supply of loans applied by the ECB. In general, the Japanese and ECB focus appeared to be more on the banking sector, as opposed to the bond market focus of the US (Fawley and Neely, 2013).

By the end of 2008 the BoJ started to use its newly established ‘complementary deposit facility’, which provided interest on excess reserves¹¹² at a fixed rate, similar to the deposit facilities found in the Eurozone since 1999, and introduced in the US in 2008. This facility creates a floor on the uncollateralised call rate and pays interest on reserves held at the central bank. Toward the end of 2009 and the start of 2010 the BoJ decided to retire some of its temporary stability initiatives and replaced SFSOs with fixed rate operations (FROs) (Vollmer and Bebenroth, 2012). The newly introduced policy differed in that loans were not provided in an unlimited amount, with an initial amount of ¥10 trillion in 3-month maturities being allocated¹¹³ (Fawley and Neely, 2013). In addition, under FROs a wider range of eligible collateral was accepted.

In April 2010, with the economy still experiencing slow economic growth, the BoJ proposed an initiative to boost growth through the provision of funds to financial institutions. By June 2010 the final details of the Growth Supporting Funding Facility (GSFF) were presented. Under this program eligible institutions were to submit proposals for one-year loans, with a possible extension to four years (Ueda, 2013). The quantity of loans under this framework was limited to ¥3 trillion. This program was extended in June 2011, with ¥500 billion worth of credit being made available. Inflation persisted close to zero per cent, and in September 2012 the BoJ increased the credit available from ¥3.5 to ¥5.5 trillion (Shirakawa, 2013).

7.4.3 Comprehensive Monetary Easing

The initial efforts of the BoJ were quite mild and, as a result, in October 2010 the Japanese economy was still struggling to recover from the financial crisis. In order to remain transparent

¹¹²Interest rate was 0.1% in December 2008.

¹¹³This was later extended to ¥20 trillion worth of 3-month maturity loans and ¥10 trillion of 6-month maturities.

regarding its policy approach, the BoJ announced a more aggressive three-pronged comprehensive monetary easing program (Kuttner, 2014). This program marked the first attempt of the BoJ at large-scale usage of its balance sheet to rectify market conditions. First, it entailed lowering of the uncollateralised overnight call rate, such that it was back to the ZLB (Vollmer and Bebenroth, 2012). Second, clarification was provided for the conditions under which the bank would exit its ZIRP program. Third, it involved the introduction of the Asset Purchase Program (APP).

The APP consists of both credit and quasi-debt management policies, with private and public assets purchased (Kuttner, 2014). However, the focus was primarily on private sector securities¹¹⁴, in order to reduce the spread between private and sovereign debt yields (Takahashi, 2013). With this program, the bank focused on reducing risk instead of term premia, similar in style to QE1 in the US. In the period from October 2011 to December 2012, additional purchases were made under the program, this time with more of a focus on the purchases of long-term government bonds. The problem with the APP was that it was quite small compared with the equivalents other countries. This seemed to indicate a lack of commitment on the side of the BoJ to implement an aggressive easing program (Kuttner, 2014).

As witnessed by the data on GDP in 2012, it seemed that the measures implemented by the BoJ were somewhat successful in promoting growth. However, the third quarter of 2012 was met by a contraction in growth, which prompted further policy action. Purchases under the APP were once again attempted, with ¥11 trillion worth of public and private assets purchased. In addition, a new framework was created to further promote lending. This new facility is called the Stimulating Bank Lending Facility (SBLF). In December 2012 Shinzo Abe became Prime Minister and announced an economic stimulus package in response to poor growth; this approach is often referred to as 'Abenomics' (Haidar and Hoshi, 2015). Three arrows are stipulated under this policy framework. The arrows of this package are flexible fiscal policy, bold monetary policy and structural reform. This plan gave rise to a shift in the thinking on monetary policy implementation (Fukuda, 2015).

7.4.4 Quantitative and Qualitative Monetary Easing

In March 2013 the BoJ appointed a new Governor, Haruhiko Kuroda, who was sympathetic to the goals of the incumbent government and critical of the passive approach followed by the BoJ in the past (Haidar and Hoshi, 2015). Similarly to Mario Draghi, the new central bank Governor

¹¹⁴Such as commercial paper (CP), asset-backed commercial paper (ABCP), corporate bonds, exchange-traded funds (ETFs) and Japan real estate investment trusts (J-REITs) (Kuttner, 2014).

indicated his resolve in ending chronic deflation and spurring economic growth (Takahashi, 2013). A new, more radical set of easing measures was suggested to replace the CME program. In April 2013 the BoJ introduced the Quantitative and Qualitative Monetary Easing (QQE) program. It entails some strong commitments on the part of the BoJ, with Prime Minister Shinzo Abe referring to the shift in monetary policy as a regime change (Kuttner, 2014). First, the bank announced an explicit inflation target of 2%, with the idea of reaching this within two years. This is aimed at changing the public's deflationary mindset (Takahashi, 2013). Second, it announced quantitative easing in the form of open-ended expansion of the monetary base to aid in achieving the stated inflation target. Initially, a total of about ¥60-70 trillion per year was set; this was to replace the APP (Haidar and Hoshi, 2015). This expansionary policy commitment also generates the expectation of a higher rate of inflation.

Third, as a qualitative measure, the bank would conduct purchases of longer-term securities, in an attempt to increase the duration of bonds held on the bank's portfolio (Kuttner, 2014). This marked the first time that the BoJ used credit easing to lower long-term rates. The balance sheet of the bank has grown significantly since the adoption of QQE, with most of the purchases coming from long-term JGBs. Purchases under the QQE program were increased to ¥80 trillion annually in October 2014, with the goal of increasing inflation more rapidly; this amendment is often referred to as QQE2. Under these expansions, the balance sheet of the bank has almost doubled in size (De Michelis and Iacoviello, 2016).

7.4.5 Negative Interest Rates

In January 2016, amid declining oil prices and depressed growth of emerging market economies, the BoJ announced that in order to meet its price stability target it was going to make an amendment to the QQE program so as to include negative nominal interest rates (De Michelis and Iacoviello, 2016). Adopting negative rates is not entirely new, and has been used before by central banks in Europe, Switzerland, Denmark and Sweden (Bech and Malkhozov, 2016). QQE with negative interest rates (QQEN) operates along three dimensions. Under this designation there are three tiers to the policy rate, with a positive, zero and negative rate applied to different portions on the current accounts of the financial institutions that interact with the BoJ. A positive rate is applied to existing balances with the BoJ, while the zero rate is applied to required asset holdings (De Michelis and Iacoviello, 2016). The negative interest rate is then applied to the balance of the current account in excess of the previously mentioned accounts. Thus far, the NIRP has been met with criticism and a disappointing response from financial markets, with an increase in the deflationary mindset.

Conclusion

This section framed the narrative of events surrounding the financial crisis and the policy response of key central banks to the global collapse. My approach was chronological, as it agrees with the development, razing and rebuilding phases associated with the crisis. The buildup of financial imbalances in the US as a result of 'ultra-loose' monetary policy, formation of a housing price bubble, deregulation of financial markets, growth in securitisation and an increasing reliance on shadow banking activities for credit provision, culminated into a perfect storm. The housing market collapse triggered a large-scale macroeconomic response that quickly spread beyond US borders. This section not only recounted these events, but considered the attempts to rebuild once the initial shock receded. The reactions by central banks were mixed and largely based on the exposure to the US financial markets. In the case of the United States the response was swift and of great consequence, while other countries were afforded the opportunity to be more measured in their attempts. The next section looks to evaluate whether policy responses were correct, with empirical evidence provided as to their success.

Part III

Balance Sheet Policies III: Empirical Evidence and Policy Consequences

An economist is a man who, when he finds something works in practice, wonders if it works in theory.

— Walter Heller (1979)

In his last public interview as Federal Reserve Chairman, Ben Bernanke, quipped that “the problem with QE is that it works in practice but it doesn’t work in theory” (Saft, 2014). In order to determine whether QE does indeed work in practice, this section is dedicated to a discussion on the empirical evidence as to the efficacy of balance sheet policies. In addition, the potential side effects from implementing such policies will be fleshed out.

8 Empirical Evidence

Following the discussion on balance sheet policies, I verify, through an analysis of the empirical evidence, the practical application of the implemented policies. The literature in this regard draws primarily on event studies¹¹⁵ and econometric analyses of episodes surrounding the most recent financial crisis¹¹⁶. I will divide the discussion thematically, looking at the impact of these policies on different dimensions of the economy.

Generally, we believe that central banks expand their balance sheets during periods when the policy has reached the ZLB (Woodford, 2012). The earliest form of quantitative easing was implemented by Japan, under its quantitative easing program (QEP). After the financial crisis, this unconventional measure was implemented by several advanced economies. The most prominent examples have been that of the US and UK, which to date have expanded their balance sheets by the largest amounts in relative terms (Gambacorta et al., 2014).

¹¹⁵This approach looks at a specific event, such as an announcement of a QE program. Researchers then consider movement in a variable of interest immediately following the event (Martin and Milas, 2013).

¹¹⁶The reason being that balance sheet policies were in full force during this time. We have limited exposure to these measures in the rest of the post-war period, as they remained mostly in the realm of theory (except for the Operation Twist experiment in the USA during the 1960’s under the Kennedy administration).

8.1 QEP in Japan

I begin my analysis by looking at the success of the Japanese QEP, which was the earliest example of a ‘pure’ quantitative easing program¹¹⁷. Expanding the supply of bank reserves in this case was done to supplant the use of the policy rate in conducting monetary policy, since the policy rate had reached the ZLB (Gambacorta et al., 2014). Increasing the size is similar in nature to a reduction in the policy rate, having the common goal of stimulating economic growth through. As suggested by quantity theorists, with this approach one would readily be able to see increases in nominal spending (Bernoth et al., 2015). The pressing question is whether this policy has generated the predicted effect in practice.

Econometric analysis of the Japanese policy experiment in the early part of the millennium indicate that it was rather ineffective in impacting the real economy (Ugai, 2007). Exploration of the economic aggregates reveals that this policy had limited impact. In spite of the monetary expansion, economic growth (and nominal expenditure) remained persistently low. More importantly, deflation appeared to be unaffected. The Japanese economy slowly started to recover toward 2006, quite long after the initiation of the program. However, further evaluation reveals that although the policy might have been unsuccessful in generating real activity, it might have been effective in shaping expectations as to the future path of the policy rate, shown by longer-term interest rates decreasing throughout the early part of the 2000s.

This might be explained in part by the change in rhetoric of the central bank with regard to policy communication. Under the QEP, the credible commitment from policymakers to ZIRP comes from the fact that they are eliminating the possibility of increasing the policy rate in future (without first decreasing the excess reserves in the economy). This could mean that eventually the promise of the central bank to keep rates low was transmitted through the expectations channel, from short- to longer-term rates (Woodford, 2012). After the crisis the BoJ moved away from simply using quantitative targets for reserves with their CME program, signalling that they did not have much confidence in QEP.

8.2 LSAPs in the US

After the collapse of Lehman Brothers, the Fed was the first to undertake increases in its monetary base. Large-scale asset purchase programs were a combination of quantitative and

¹¹⁷Woodford (2012) defines ‘pure’ QE as a change in the size of the balance sheet of the bank without any accompanying compositional changes.

credit easing, with unsterilised purchases of both private and public securities. QE implemented by the Fed differed dramatically from the QEP of Japan, both in terms of magnitude and rhetoric. There was a clear communication strategy, with the goal of lowering expectations with respect to the future policy rate (Gagnon et al., 2011).

The literature on the effects of QE can be divided broadly into two categories. The first is the research that aims to look at the short-run policy impact, mainly through the effect on asset yields. Research in this category is mostly characterised by event studies, although attempts have been made to quantify effects through time-series analysis. These studies usually utilise high-frequency data, capturing the immediate effect of announcements¹¹⁸ concerning QE programs on financial variables (Meinusch and Tillmann, 2015). The second is a longer-term look at the impact of QE on the broader macroeconomy. Initial evidence on aggregate nominal expenditure shows little to support the idea that QE had an immediate impact on the real economy. In the case of the US, the size of the balance sheet was almost quadrupled in the first four years after the crisis, with only a modest increase in the growth of nominal GDP (Woodford, 2012). However, the stated short-term objective of QE was to reduce market yields of long-term bonds, which would then eventually translate into increased availability of credit to firms and households (Woodford, 2012).

8.2.1 Effect on Long-term Security Yields

Econometric proof as to the existence of a reduction in long-term rates (flattening of the yield curve) through LSAPs¹¹⁹ has been easy to come by, but proper identification of the transmission channels has been more difficult (Krishnamurthy and Vissing-Jorgensen, 2011). Modelling the complete transmission mechanism through which long-term rates operate has proven difficult, as the mechanism is poorly understood. Generally, the effect of central bank asset purchases on longer-term asset yields can be thought to affect two elements: a risk premium of some kind and the average short-term interest rate expected over the term to maturity (Gagnon et al., 2011)¹²⁰. With the portfolio balance channel, asset purchases look to affect long-term interest rates through their impact on risk premia. Purchases of assets with long durations are swapped for bank reserves, to affect the relative supply of long-term assets and, thereby, the asset yield.

¹¹⁸Once point of contention in these studies is the length of the event “windows”. They normally range anywhere from 30 minutes to 3 days. A short window may perhaps miss some of the market reaction, while a longer window could include market effects unrelated to the announcement.

¹¹⁹Especially in the earlier rounds of QE, when the announcements were a complete surprise to market participants

¹²⁰As an example, in the purchase of long-term government bonds, the two components of the decomposition are the term premium and average short-term interest rate over the maturity of the bond (known as the risk-neutral rate) (Bauer and Rudebusch, 2014).

According to a statement by the Fed Chairman at the time, Ben Bernanke, the Fed intended for LSAPs to work through the portfolio balance channel (Bauer and Rudebusch, 2014). In the case of the signalling channel, the mechanism works by changing expectations about the future of the short-term rate (Christensen and Krogstrup, 2015).

Several event studies, such as those by Gagnon et al. (2011), Krishnamurthy and Vissing-Jorgensen (2011), D'Amico et al. (2012), Glick and Leduc (2012), Rosa (2012), and Neely (2015), have determined that the Fed was successful in reducing long-term rates through its spectrum of QE initiatives. Combining time-series and event-study methodologies, the study by Gagnon et al. (2011) is among the earliest to try and capture the portfolio balance effects of QE1. The identification strategy in the event-study methodology relies on the fact that announcements were a surprise to market participants. Immediate shifts in asset prices following these announcements show the true pass-through to bond yields, as opposed to the effect of anticipated monetary policy (Rogers et al., 2014).

Using the Kim-Wright term-structure model and event-study methods, the study of Gagnon et al. (2011) reveals that positive QE announcements cause significant reductions in the long-term interest rates of several securities. In particular, they found that the 10-year Treasury term premium dropped significantly in response to QE1 announcements, with the response of longer-term interest rates on MBS and agency debt showing an even stronger reaction¹²¹. They assert that while asset purchases were effective at lowering risk premia, they failed to shape expectations as to the future of the short-term policy rate (Gagnon et al., 2011). Emphasis is placed on the portfolio balance channel while reducing the role for a signalling channel. The results of Gagnon et al. (2011) are reinforced by the term-structure estimates of Hamilton and Wu (2012), who find a large and significant portfolio balance effect in a preferred habitat model, similar to that of Vayanos and Vila (2009).

Findings provided by the event study of Krishnamurthy and Vissing-Jorgensen (2011) suggest that the portfolio balance channel¹²² is the most important driver of the reduction in long-term rates, but that the signalling and liquidity channels also contribute significantly¹²³. Empirical evidence provided by Woodford (2012) indicates that there is a strong signalling channel component. In fact, Bauer and Rudebusch (2014) contest the claim of Gagnon et al. (2011) that the signalling channel is unimportant, citing concerns over small-sample bias in their term-structure model. Their revision of the model of Gagnon et al. (2011) aims to correct for bias and statistical uncertainty. Estimates from this revised process illustrate the extent to which the signalling channel was understated in previous attempts. The paper by Gagnon et al. (2011)

¹²¹This is not surprising considering that QE1 focused primarily on purchases of these securities

¹²²Although they refer to it as the safety channel

¹²³The liquidity channel does not appear significant in QE2.

only credits about 30% of the movement of long-term rates to the signalling channel, while Bauer and Rudebusch (2014) identifies the value to be between 30% and 65%.

8.2.2 Effect on the Real Economy

While some models focused on the short run impact on asset yields, others tried to determine what impact QE has had in the longer-run on the real economy. During the crisis the policy rate reached the ZLB, which meant that economies had to switch to LSAPs. It is important therefore to verify whether these programs that supplant the traditional policy tool would be able to spur economic growth and prevent deflation (Baumeister and Benati, 2013). Several econometric methods have been used in this pursuit, such as SVARs, TVP-VARs, Markov-switching VARs (MS-VAR), large Bayesian VARs (LBVAR), FAVARs and panel VARs (P-VAR) (Bork, 2015). Unfortunately, the small sample size has made these evaluations difficult to accept.

Preliminary results of a counterfactual constructed by Chung et al. (2012) reveal that without the policy intervention, the economy would have experienced decreased growth and inflation, in addition to increased unemployment. Similar results were reached with the DSGE models of Del Negro et al. (2013) and Chen et al. (2012a), which incorporate the effect of LSAPs on the broader macroeconomy.

Baumeister and Benati (2013) used a TVP-VAR to measure the impact of a 60 basis point increase in the 10-year term spread, which results in 0.9% lower GDP, 1 percentage point lower inflation and the unemployment rate increased by 0.75 percentage points (Baumeister and Benati, 2013). In order to determine whether output and price levels react to LSAPs in the US, Weale and Wieladek (2014) used a BVAR model with several different identification specifications. In this setup they found a positive and significant effect on the real economy resulting from an asset purchase shock, with a 0.36% increase in real GDP and 0.38% increase in CPI from the purchase of a government bond worth 1% of nominal GDP (Weale and Wieladek, 2014).

Another approach is that of Meinus and Tillmann (2015), who used a Qual VAR (QVAR) model, in which they found that QE had been effective in stimulating real activity. With a similar result, Bork (2015) found a significant impact on the real economy resulting from the LSAPs using a dynamic factor model. He found that “industrial production, capacity utilization, inflation, and employment have significantly positive responses, and unemployment is significantly reduced” once an unconventional policy shock is applied (Bork, 2015). In addition, in the case of a counterfactual, Bork (2015) found that a significant downturn in the economy was avoided by the asset purchases.

8.3 QE in the UK

Once the traditional monetary policy route was exhausted, the BoE used QE to promote growth, and FLS to inject liquidity and address dysfunctional financial markets; this most closely resembled the strategy followed by the US (Churm et al., 2015). Similar studies were performed, with the results resembling those of the US. Policies were primarily differentiated by the size of the programs implemented, with the QE of the BoE being much smaller in comparison to that of the US. Programs looked at in this section, as used in the UK, are QE and FLS. Studies are grouped according to their impact on the economy.

8.3.1 Effect on Long-term Security Yields

In a similar fashion to that of the research for the US, event studies were first used to attempt measuring the short-term effect of gilt purchases on the yield spreads in the UK economy. Relative to research on the unconventional measures of the Fed and ECB, studies on the policy actions of the BoE are limited. Important contributions in this literature include Meier (2009), Meaning and Zhu (2011), Joyce et al. (2012b), Breedon et al. (2012) and Churm et al. (2015), with most of the research focusing on the first phase of quantitative easing. Research performed on the UK economy is largely comparable to that of the US in terms of methodology.

Casual empirical observation reveals that the range of credit facilities and quantitative easing mechanisms put into play in 2009 resulted in increasing asset prices as well as significant decreases in the yields of both government and corporate bonds (Joyce et al., 2012b). Early studies that estimate the immediate impact on financial markets, through an event-study approach, are those of Meier (2009), Joyce et al. (2012a) and Meaning and Zhu (2011). Using counterfactual analysis (constructing scenarios in which policy did not occur), Meier (2009) found that initial QE announcements resulted in a reduction of gilt yields by between 35 and 60 basis points. In the work of Joyce et al. (2012a), they found that longer-term gilt yields fell by at least 100 basis points in total for the period 2009 - 2010, with a similar narrowing in corporate bond yields.

In utilising the event-study methodology there is a general disagreement in the literature about the exact approach to follow. However, most studies agree that QE contributed to the lowering of yields, as was the case for the US, especially with regard to longer-term securities. In addition, there is a consensus that the portfolio balance channel, which is sometimes decomposed into local supply and scarcity effects, is the primary channel of operation (Joyce et al., 2012b). Increased transparency with respect to QE policy changes in the UK has meant

it has become increasingly difficult to identify the impact of announcements on bond yield spreads (McLaren et al., 2014). Event studies, in particular, rely on the surprise component of policy announcements. Widely anticipated policy announcements dampen market reactions, which has led some research to show a decrease in the ability of purchases to affect asset prices (Churm et al., 2015). More recent studies, such as those of Butt et al. (2012), McLaren et al. (2014) and Churm et al. (2015), attempt to evaluate the relative impact of the QE2 program, looking specifically at the financial market impact of this policy.

In terms of the effect on broad money aggregates, Butt et al. (2012) found that the effect has been largely the same over time, with transmission channels being the primary difference. Using a principal components model and counterfactual analysis, Churm et al. (2015) found that even though there was a significant reduction in gilt yields with QE2 across medium- to longer-term gilts, the registered impact across all yields was substantially lower than found during QE1. McLaren et al. (2014) believe that an explanation for the decreased impact of QE2 is the decrease in contribution from the signalling channel. In their study they found that the local supply effect (an element of the portfolio balance channel) is similar over time, between 40% and 60% of changes in asset yields, suggesting that other transmission channels are responsible for the change.

In addition to estimating the impact of QE2 on asset yields, the article by Churm et al. (2015) looks at the newly developed FLS. In particular, they are interested in the scheme's influence on marginal funding costs, similar to the study of Kapetanios et al. (2012). The conclusion reached by Churm et al. (2015) is that the introduction of FLS resulted in a drop in bank wholesale funding spreads.

8.3.2 Effect on the Real Economy

There is a dearth of literature on the broader macroeconomic implications of asset purchase programs in the UK. Kapetanios et al. (2012) use a variety of models, such as BVAR, MS-VAR and TVP-SVAR, to determine the real economy impact of the QE programs. Empirical results suggest that the programs that were implemented greatly improved economic conditions, and that in their absence GDP and inflation would have been much lower, perhaps even reaching negative values. Conservative estimates of the positive effect on real GDP puts it at 1.5%, while inflation rose by at least 1.25% as the result of QE. Similar estimates are found in the work of Baumeister and Benati (2013).

In their paper Weale and Wieladek (2014) impose an asset purchase shock in a BVAR framework, worth 1% of nominal GDP, to determine the effect on the real economy, which delivered a

0.18% increase in real GDP and 0.3% increase in CPI. Also utilising a BVAR model, Churm et al. (2015) conducted an out-of-sample forecast to determine how the landscape of the UK economy would have differed if QE had not been implemented. An assumption was made, based on event-study evidence that the stimulus reduced spreads by up to 45 basis points. In other words, the counterfactual scenario assumed that QE2 reduced the yield spread by 45 basis points. Stimulating the economy through asset purchases was found to have the equivalent impact of reducing the policy rate by between 1.5% and 3%, which roughly increased nominal GDP by 0.6% over one year and inflation by between 0.25 and 0.6 percentage points. Churm et al. (2015) also studied the impact of a lower marginal funding cost, as the result of FLS. They found that the impact of the scheme is similar to that of QE2, with a 0.8% increase in GDP growth and a 0.6 percentage point increase in inflation, after a year from the start of the policy.

8.4 LTROs, SMP, OMT and PSPP in Europe

The ECB also implemented liquidity injections and asset purchases throughout the crisis, but these were mostly sterilised operations and did not increase the size of the balance sheet. The first instance of expansion of the balance sheet was through the Public Sector Purchase Programme, which was implemented in 2015. Unfortunately, due to the fact that this program was announced only quite recently, there is little relevant research on the topic, with the work of Altavilla et al. (2015) being the only published research on the topic. However, there are several studies that look at the financial market impact of the ECB's policy initiatives. Usually, these studies look at one of three markets, namely, money markets, covered bond markets and sovereign bond markets (Szczerbowicz, 2015).

Early attempts by the ECB to rectify the position of failing financial markets were focused primarily on LTROs. The impact of these exceptional liquidity provisions on interbank lending was studied through basic regression analysis in the work of Abbassi and Linzert (2012), (Angelini et al., 2011) and Brunetti et al. (2011). From these studies the general consensus is that the introduction of a range of LTROs did not contribute significantly to reducing relevant money market spreads. In other words, this policy avenue was not particularly useful in combating financial market instability.

Of particular importance is the liquidity provided under the 3-year LTROs¹²⁴, which Carpinelli and Crosignani (2015) refers to as the “largest liquidity injection ever conducted”, totaling \$1.37 trillion to 800 banks. They show that these liquidity injections positively affected Italian credit

¹²⁴These are also known as very long-term refinancing operations (VLTROs) (García Posada and Marchetti, 2015).

supply. In a similar study Andrade et al. (2015) found that these LTROs positively impacted credit extension in France. In addition, García Posada and Marchetti (2015) argues that VLTROs increased loan supply in Spain. Szczerbowicz (2015) found that only 3-year LTROs (in combination with ZIRP) contributed to removing some of the tension in stressed interbank markets, which is consistent with the result of Darracq-Paries and De Santis (2015).

Lenza et al. (2012) consider the macroeconomic effects of unconventional policies implemented during the period of enhanced credit support, before the creation of the SMP. Using a large BVAR model to construct a counterfactual, they determined that facilities created under ECS (specifically looking at FRFA) helped to reduce money market spreads, which translates into improved financial market health (Lenza et al., 2012). In addition, the ECS operated in much the same way as conventional monetary policy, by increasing industrial production by 2% and decreasing the unemployment rate by 0.6 percentage points. The BVAR analyses of Giannone et al. (2011) and Baumeister and Benati (2013) corroborate the evidence that policy intervention supported market functioning by reducing money market spreads, thereby restoring the transmission mechanism of monetary policy, which helped to increase real activity across the Eurozone.

Asset purchase strategies of the ECB during the sovereign debt crisis were subject to fierce academic and policy debate. The overwhelming majority of papers turned to the evaluation of the sovereign bond market impact of policies implemented, specifically focusing on SMP and OMT. In general, these papers looked toward the effect on asset yield spreads and the volatility associated with yields (Eser and Schwaab, 2016). Importantly, the ECB intervened in failing secondary sovereign debt markets, which had broader implications for the Euro area as a whole. I first evaluate the impact of the SMP and then the OMT (which later replaced the SMP).

The SMP was considered a temporary initiative to help stabilise the Euro economies and prevent the collapse of the monetary union. The language used by the ECB described measures that were used to restore the transmission mechanism of monetary policy (Eser and Schwaab, 2016). SMP, unlike QE in the UK and US, was not intended to be a replacement for the short-term overnight interest rate. In other words, it was meant to normalise the movement of sovereign bond yields, not to be an accommodative monetary policy. As a result, studies rarely consider the broader macroeconomic implications of the program, as it was not intended to boost growth or deter deflation (Szczerbowicz, 2015).

According to several studies, the initial announcement of the SMP and OMT had a powerful effect on sovereign bond yields, with the program acting as a commitment to save the monetary union. Sovereign bond spreads for the Eurozone periphery narrowed significantly following

the announcements, as documented by Pattipeilohy et al. (2013), Krishnamurthy et al. (2014), Ghysels et al. (2014), Pooter et al. (2015), Acharya et al. (2015) and Falagiarda and Reitz (2015). However, it is argued by Eser and Schwaab (2016) that the announcement effect was not the primary driver, with actual bond purchases being more impactful in terms of lowering yield spreads and yield volatilities of sovereign bonds.

Using a panel regression, the ‘impact identification’¹²⁵ strategy performed by Eser and Schwaab (2016) on daily data reveals that bond purchases by the ECB under SMP decreased 5-year bond yields across a range of countries most affected by the sovereign debt crisis¹²⁶. In general, the SMP appears to have had a stronger impact on the shorter end of the yield curve. Szczerbowicz (2015) used internal ECB data and found that purchases within the SMP and OMT had significantly lowered covered bond and sovereign yield spreads.

According to Eser and Schwaab (2016), SMP operated through three primary channels. First, reduction of liquidity risk premia through the lender-of-last resort function of the ECB. Second, local supply effect, whereby reducing supply in a specific market increases price on that asset and lowers the yield. Third, the default risk, which is reduced through country specific asset purchases to help avoid sovereign debt default. Interestingly, since the SMP was temporary in nature, and did not contain any information as to the policy stance of the ECB, we do not expect any signalling effect from these purchases (Krishnamurthy et al., 2014). In the work of Krishnamurthy et al. (2014), they found that the dominant channels through which sovereign bond yields were affected by the SMP and the OMT were through default risk and sovereign bond segmentation (local supply) effects.

More recently, the work of Altavilla et al. (2015) looked at the impact of the Asset Purchase Program. The APP contains the PSPP as one of its policy arms, with the PSPP being the first true instance of unsterilised balance sheet expansion implemented by the ECB. They found that this APP resulted in a sizeable reduction in yields across a wide range of assets. In addition, these effects seem to intensify with an increase in the maturity and riskiness of the targeted asset. Estimates of the yield impact delivered an average reduction of 30 to 50 basis points on bonds with a 10-year maturity. Driffill (2016) found that APP resulted in the reduction of 10-year government bond yields in troubled economies, reducing differentials between countries of the Euro area.

A comprehensive event study by Falagiarda and Reitz (2015) looked at spillovers to Central and Eastern Europe from the range of nonstandard policy measures implemented by the ECB since

¹²⁵This exploits both cross-sectional and time series components of the data. Yields might have risen in many of the countries in the sample due the announcement, however, using this strategy we are concerned only with relative movements.

¹²⁶These countries include Greece, Italy, Spain, Portugal and Ireland.

2007, including the newly formed APP. They found a strong announcement effect emanating from the SMP, while the OMT and PSPP had a limited impact. They identify the primary channels of transmission for nonstandard policies as the portfolio balance, signalling and confidence (redenomination risk) channels (Falagiarda and Reitz, 2015).

8.5 CME and QQE in Japan

I end the balance sheet policies narrative with the empirical evidence supplied on the Japanese economy. Since the adoption of the QEP in 2001, several other central banks have emulated the strategy, incorporating unconventional policy measures as part of their policy toolkit. Evidence as to the efficacy of nonstandard policies implemented is becoming more abundant. As previously stated, most of the research has been on the LSAPs of the US. However, the introduction of CME and especially QQE has garnered the attention of several international researchers.

8.5.1 Effect on Long-term Security Yields

As in the other sections on empirical evidence, most of the research has been conducted to determine the short-term financial market impact of asset purchases. Schenkelberg and Watzka (2013) found that QE under CME resulted in a reduction of long-term interest rates, in a similar manner to that of LSAPs in the US. Transitory increases in output and inflation were also observed with this SVAR approach. Rogers et al. (2014) examine the effect of several nonstandard policy announcements on asset prices, with policy shocks resulting in a reduction of 10-year JGBs and corporate bond yields. Although this was not necessarily the intended effect from asset purchases, with the BoJ explicitly stating that it wanted to affect the real economy, specifically inflation.

Interestingly, the study of Ugai, Hiroshi (2015) points out that the signalling channel was important in the dissemination of the effect of CME, but this channel does not appear to be important under QQE. In particular, QQE caused a sharp depreciation of the yen, which is thought to operate through the portfolio balance channel. The yield of longer maturity JGBs declined with the introduction of QQE, but this reduction did not filter through to corporate bond yields (Ugai, Hiroshi, 2015). The study of Hausman and Wieland (2015) also found that the yen experienced a strong depreciation under Abenomics, as well as an increase in Japanese stock prices.

8.5.2 Effect on the Real Economy

One of the stated objectives of Abenomics has been to reach an inflation target of 2% in the space of two years (De Michelis and Iacoviello, 2016). This target was not reached, but inflation has turned positive for the first time in 15 years, indicating that it has been somewhat successful. In their paper, Hausman and Wieland (2015) show that the approach of the BoJ with Abenomics was successful in providing a small increase to output, but inflation remains well below the intended target. However, they believe that the cost of the program is justified. Matsuki et al. (2015) showed, using an MS-VAR, that expansion of the balance sheet resulted in lowering short-term market rates and increasing inflation. De Michelis and Iacoviello (2016) used both VAR and DSGE analyses to conclude that the nonstandard policies implemented by the BoJ have been effective in the battle to overcome deflation; however, due to credibility concerns, the BoJ has not reached its intended target. Bolder measures are required if real activity is to be bolstered and deflation defeated (De Michelis and Iacoviello, 2016).

9 Other Implications of Using Balance Sheet Policies

Balance sheet policies were undoubtedly crucial policy instruments during and after the financial crisis. Nonetheless, all remedies have side effects; it is simply the severity that differs. Concerns over unintended consequences of balance sheet policies were first voiced with the initial rounds of QEP in Japan. However, due to the unprecedented scale and pervasive usage of balance sheet policies after the financial crisis, concerns over the potential ramifications have been amplified. Some of the potential adverse consequences include international spillover effects, loss of central bank independence, the creation of moral hazard, permanently inflated balance sheets (no exit strategy), inflation and the depreciation of currency. These potential consequences are discussed in this section, with a focus on the primary disadvantages recorded from recent policy experiments.

9.1 Central Bank Independence

British economist David Ricardo wrote in 1824 that governments should never be entrusted with the power to issue paper money, as this would ultimately lead to inappropriate servicing of public debt. His solution was to establish an independent monetary authority not subject to political influence. In fact, the central bank should “never, on any pretence, lend money to

Government, nor be in the slightest degree under its control or influence” (Ricardo, 1888). In the rest of this section I aim to show that political intervention in the process of money creation could severely affect the functioning of the monetary transmission mechanism, potentially causing inflation to become unmanageable.

9.1.1 Types of Central Bank Independence

There are different concepts of central bank independence. Two broad classifications emerge from the literature. First, independence of objective, or goal independence, allows an organisation to determine which objectives to pursue, without input from political authorities (Ćorić and Cvrlje, 2009). Central banks do not generally have goal independence, as this would encourage opportunistic behaviour and lacks accountability, allowing the monetary authority to restructure goals so as to allow deviations from predetermined objectives¹²⁷.

Second, one of the attractive features of the modern central bank is that it is free to achieve its mandate without regard for political agenda, using whichever instrument it chooses (Bernanke, 2010). Being able to use the tools of monetary policy to achieve stated goals without interference is at the heart of what is called instrument (or operational) independence.

Instrument independence is a multidimensional concept. The ability to pursue policy objectives requires the central bank to have political, technical and financial independence. Political independence means that central banks do not receive assistance or take instruction from government bodies in pursuit of their stated goals. Technical independence refers to the ability of the central bank to use monetary policy tools as they see fit. In addition, they are not allowed to use these tools for goals outside of their mandate, such as the monetizing of government debt. Finally, financial independence means that the central bank has to have control over its own balance sheet, with a budget separate from that of the government (Buiter, 2009).

9.1.2 Motivation for Central Bank Independence

There are several reasons government needs to be separated from the monetary authority. First, political intervention in the operations of the central bank can potentially damage the credibility of the monetary authority. While the central bank might be committed to a low inflation target,

¹²⁷Interestingly, the Fed has a limited form of goal independence, vaguely assigned the dual mandate of achieving maximum employment and price stability. The Fed has much room to move in its interpretation of maximum employment (Ćorić and Cvrlje, 2009).

the fiscal authority could cause a deviation from this objective by using policy to pursue higher growth. Political authorities, as argued by (Orphanides, 2008), are tempted to seek inflationary conditions, with a potential trade-off in the short-run between an immediately realised increase in economic activity and higher inflation down the line¹²⁸. Policymakers have a vested interest in creating jobs and boosting economic growth in the present, even at the risk of increasing inflation in the future, especially during election years (Corsetti and Dedola, 2013).

Public policymakers who systematically push the economy beyond its productive capacity could plausibly set in motion a spiral of increasing inflation and inflation expectations, without an associated improvement in real economic conditions (Bernanke, 2010). In other words, inflating the economy to achieve higher output will only end up causing higher inflation, without any gain in economic activity in the longer-run¹²⁹. The disadvantages of deviating from a stated policy objective are well recorded, both theoretically and empirically. A wealth of knowledge gained from the ‘time-inconsistency’ discourse advises monetary authorities to abide by their mandate¹³⁰.

Second, a fiscal authority with control over the central bank may attempt to print money to service a budget deficit (Bernanke, 2010). Monetisation of debt through the printing of money by the government eventually leads to high levels of inflation and volatility in the economy. Politicians might run budget deficits and accumulate debt with the idea that future governments will carry the cost, or perhaps that debt can be reduced through inflation (Orphanides, 2008). The only way in which the government could retain control over money creation is if the public trusted it not to pursue growth objectives to the detriment of price stability. However, in lieu of this trust of the public, it would be better to designate the role of price stability to an independent organisation (Orphanides, 2008).

9.1.3 The Role of Central Bank Independence

The discussion on the effectiveness of monetary policy in combating inflation intensified during the 1970s. This period was characterised by high levels of inflation and low economic growth, referred to as stagflation. Researchers, policymakers and the public wanted an explanation as to the sudden impotence of monetary policy with regard to lowering inflation and boosting

¹²⁸This relationship is depicted by the Phillips curve, which illustrates the potential for a short run trade-off between inflation and employment. Taylor (1998) categorises this relationship as one of the five things we know for sure about economics.

¹²⁹The reason for this is that private agents with rational expectations anticipate attempts to exploit the relationship and adjust inflation expectations upward, arguments originally made by Thomas Sargent and Robert Lucas

¹³⁰Notable contributions are that of Kydland and Prescott (1977), Calvo (1978) and Barro and Gordon (1983).

economic growth. It was a commonly held Keynesian belief that increasing inflation on the part of the monetary authority would reduce unemployment¹³¹. However, inflation persisted in conjunction with deteriorating real macroeconomic performance, despite central bank intervention (Berger and Kißmer, 2013).

It was in response to these events that the literature on time-inconsistency and rational expectations emanated¹³². Arguments originally developed by Friedman (1968), Lucas (1976) and Kydland and Prescott (1977) were later confirmed by Barro and Gordon (1983), who found that monetary authorities were, in fact, setting inflation targets too high, pushing economies beyond their natural levels of output. This caused inflation to increase without the resulting growth benefits. The agreed-upon cure was to implement a price stability objective for the central bank, which now had instrument independence. This episode is remarkable in that academic research was effective in bringing about changes to monetary policy practice that resulted in a new consensus on how policy should be conducted.

The new consensus assigned central banks the mandate of achieving price stability. As highlighted by theory, achieving this goal depends heavily on central bank independence, transparency and accountability (Bernanke, 2010). Inflation targeting, through adopting the inflation rate as a nominal anchor, greatly decreased inflation and output volatility. Empirical evidence supports the idea that central bank independence is key to achieving desired inflation outcomes¹³³. It is therefore not surprising that dissidents of unconventional policy measures identify the potential loss of central bank independence as too costly to ignore.

9.1.4 Balance Sheet Policies and Central Bank Independence

Balance sheet policies immediately raise concerns about the independence of the central bank. I identify two broad streams of argument made in the literature about the impact of unconventional monetary policy on central bank independence. There is some overlap between these categories, but they are largely distinct from each other. First, there are discussions about the budgetary independence of central banks with the introduction of asset purchases. Second, a large literature has formed on the portfolio management of assets purchased by central banks after the crisis. In the next section, I discuss some suggestions made to quell these fears.

¹³¹Known as the Phillips curve trade-off, which was first suggested by Phillips (1958) and later popularised by Samuelson and Solow (1960).

¹³²Although it is a fascinating literature, it is not worthwhile delineating all the relevant arguments in this section.

¹³³The related literature includes, but is not limited to, Grilli et al. (1991), Cukierman et al. (1992), Summers and Alesina (1993) and Cukierman et al. (2002).

9.1.4.1 Budgetary Independence In the previous section, it was established that instrument independence is vital in achieving price stability. However, with the start of the crisis, it is not the loss of the freedom to use the tools of monetary policy that is mourned¹³⁴; instead, budgetary or financial independence has become the focus of discussion¹³⁵. In normal times, central banks have a certain structure to their balance sheet. Liabilities consist primarily of currency and reserves, while the asset side contains Treasury securities (Dudley, 2013). As the central bank did not hold private sector assets, there was no credit risk on the portfolio. It is possible for the central bank to hold long-term government bonds, which implies some interest rate risk. However, as these long-term bonds are usually held to maturity, it eliminated much of the associated risk (Dudley, 2013). Notably, central banks typically secure some degree of profit, which they then remit to the Treasury.

Unconventional monetary policy can have fiscal consequences. Large-scale asset purchases and maturity transformations could plausibly be unfavourable for the central bank's asset risk profile, and the level of profits remitted to the Treasury (Rossi, 2013). This is of particular relevance if central banks wish to intervene in financial markets outside of the traditional banking sector (Goodfriend, 2007a). Purchases of private sector assets (such as MBS) and long-term government securities result in the central bank adopting the risk associated with the asset.

Broadly speaking, two types of risk are created, credit risk and interest rate risk. First, credit risk is considered the most damaging, as the central bank has little control over private asset markets. Purchases of these private sector securities expose the central bank to the volatility of the associated markets. Second, increasing long-term debt translates into greater interest rate risk. Normally, these assets would be generating income for the central bank, as has been the case in most countries. This means that the government receives seignorage revenue from these investments, as illustrated in the case of the US in Figure 10. However, if long-term interest rates increase, or money market investments turn sour, there could be a cessation of the stream of seignorage revenue.

Earnings from these securities could also be negative (creating a budget deficit), which means the central bank could experience losses. Increasing interest on reserves, as in the US, makes this situation even worse, as interest needs to be paid on this debt (Dudley, 2013). Small, temporary, losses experienced by the central bank should not, however, be a cause for concern, as the burden could be shifted by increasing remittances at a later stage when the central bank becomes profitable again (Del Negro and Sims, 2015). However, in the case of the recent crisis,

¹³⁴Sometimes referred to as technical independence. The central bank still has technical independence, even when the policy rate reaches the ZLB.

¹³⁵According to certain definitions, financial independence forms part of operational independence.

the sheer size of asset purchase programs amplified the potential budget risk. If losses are large, the bank might not be able to retain control over its balance sheet.

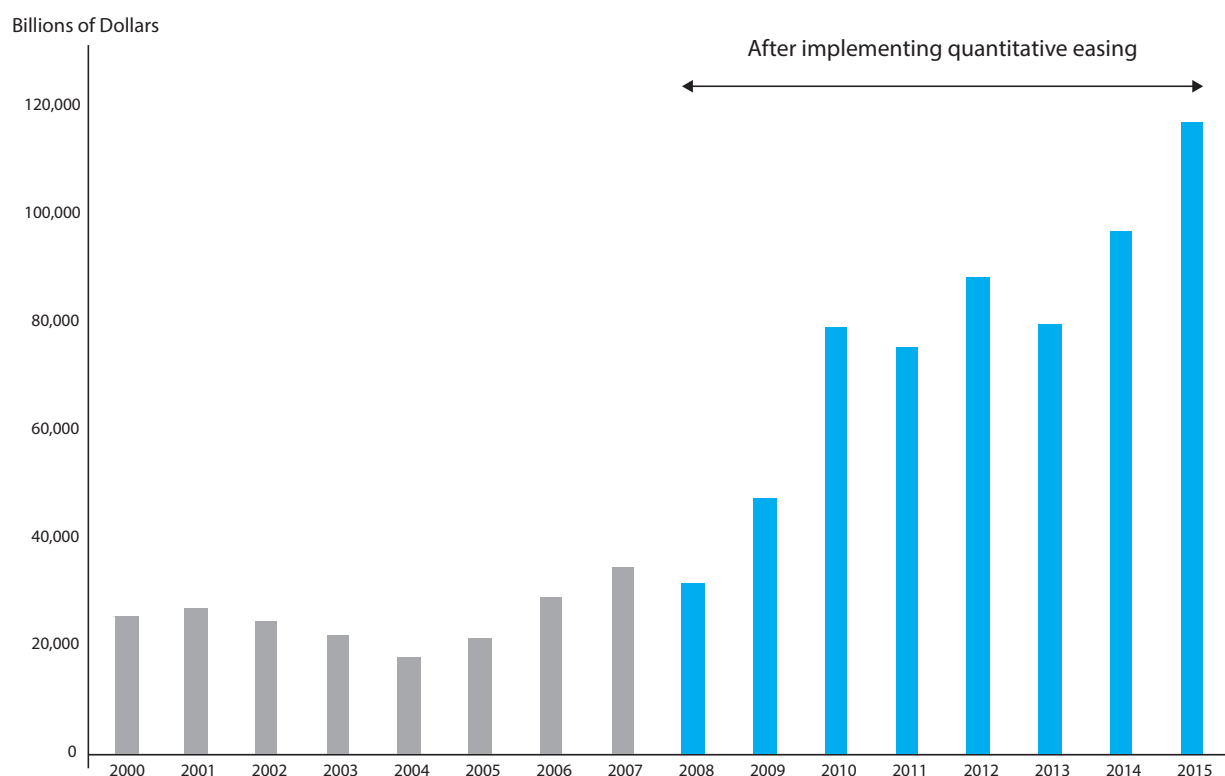
One of the most hotly debated topics at the moment, is whether central banks should be allowed fiscal support when the “system’s net worth at market value is negative” (Del Negro and Sims, 2015). In order fully to appreciate this discussion, a distinction needs to be made between fiscal support and fiscal backing. Fiscal support is defined as the “commitment by the treasury to recapitalize the central bank if necessary”. Fiscal backing, however, refers to the behaviour of the fiscal authority to ‘back’ the inflation target set by the central bank, making sure inflation is guided primarily through monetary policy (Reis, 2015). Fiscal backing is coordinated behaviour that cannot be managed by the central bank on its own (Del Negro and Sims, 2015). As illustrated in the literature, for the price level to be uniquely determined, fiscal authorities need to limit their interference in monetary policy affairs (Woodford, 2003).

Fiscal backing does not imply fiscal support, and vice versa. At the moment few countries have fiscal support when it comes to making losses from investments in private credit markets. Some central banks, like the BoE, are indemnified fully by the Treasury against any loss occurring from their unconventional monetary policy spending, while other central banks have constructed charters to deal with negative dividends (Reis, 2015).

However, if the central bank receives no recapitalisation, this might influence its ability to conduct policy. If the government does not tolerate losses, then the central bank cannot guarantee price stability (Goodfriend, 2014). Without the support, the central bank would try to influence inflation in order to devalue its stock of outstanding debt, which means perhaps allowing more inflation than needed (Belke and Polleit, 2010). Seignorage revenue generated (i.e. printing money) could settle their debt, but at the cost of inflation, which means that they are not pursuing their policy objective. This option can cause severe reputational damage; potentially undermining established trust in the ability of the central bank to achieve its policy objective.

9.1.4.2 Asset Management and Moral Hazard During the financial crisis, several lending facilities were created by central banks, often in close coordination with fiscal authorities. The financial institutions selected to receive credit were based on apparent need. However, because of the coordination with government agencies, this opened up the possibility that the selection of market intervention could have a political agenda (Bordo, 2010). One concern is that in the pursuit of this seignorage revenue, the government could perhaps try to influence the investment decision of the central bank, potentially forcing it to contradict its mandate (Del Negro and Sims, 2015).

Figure 10: Remittances from the Fed to the US Treasury



Source: Annual report of the Federal Reserve Board of Governors

While the goal of most central banks, which adopted nonstandard policies, has been to persuade private banks to lend, it has unearthed another interesting problem. Intervention in credit markets can create unnecessary speculation and associated volatility in asset markets (Plosser, 2009). Influencing asset prices and credit allocation also gives the central bank a lot of power. In practice this has allowed the central bank to behave like a large investor in specific market segments, managing a relatively large portfolio of assets that affects market activity. Unfortunately, this makes it the target of political pressure, opening it up to lobby groups.

The ability to intervene in specific market segments also creates moral hazard, allowing institutions to believe that they will be bailed out at the first sign of distress, inherently promoting even riskier behaviour. As I have mentioned in my discussion on the crisis, one of the reasons the financial agents engaged in risky behaviour is that they believed banking institutions to be of such systemic importance that they would not be allowed to fail. The central bank's lender-of-last-resort function, for example, institutionalises this idea, stating that struggling financial institutions need to be provided support. In addition, if the central bank is responsible for banking supervision, then it will need to use taxpayer money to fund the strategic resolution of these institutions (Rossi, 2013).

9.1.5 Suggestions

Several suggestions have been put forward as to how one could resolve issues on central bank independence. In general, central banks need to be transparent when it comes to the link between the fiscal and monetary authority, showing that a coordinated effort is taking place. It is essential that the objectives of policies be explained in detail, in order to leave no doubt about the policy direction. One solution, as mentioned before, is for governments to provide fiscal support (indemnifying losses) in the unlikely event of central bank budget deficits. This could be done through the creation of an institution that absorbs losses, such as in the case of the BoE.

Another suggestion is that of Bernanke (2010), who believes that the same independence should be extended to unconventional policies as that enjoyed by the conventional monetary policy measures. In other words, one would try to remove the influence of government when it comes to nonstandard policies; for example, assigning the central bank some financial stability objective to reach using unconventional tools, without interference from the fiscal authorities.

Finally, there is a proposal for the delineation of fiscal and monetary authorities in handling the assets of the balance sheet of the central bank. Non-treasury securities can form part of the fiscal budget, while the central bank is left with Treasuries on its balance sheet. This resolves some of the issues over the exit strategy and its interaction with price stability (Plosser, 2009). With that, I now move to the topic of exit strategies with respect to unconventional monetary policy.

9.2 Exit Strategies

Assets on the balance sheet of the Federal Reserve have grown by more than 5 times in the last nine years, from a value of \$869 billion in August of 2007 to \$4.6 trillion in July 2016. While growth was not quite as aggressive in the majority of developed countries, there have been significant expansions. A fourfold increase of the assets for both the Bank of England and the Bank of Japan have been recorded, while the Swiss National Bank has experienced an increase in the size of its balance sheet from “20% of nominal GDP to more than 80% of nominal GDP” (Ihrig and Meade, 2015). Economic growth and increased inflation in countries with bloated balance sheets has raised the question as to how these economies will return to the usage of their conventional policy instruments. In fact, these pressures have forced the Fed to exit from its LSAPs, implementing a normalisation program in October 2014.

9.2.1 The New Normal

Economic recovery might initiate a process in which commercial banks start lending out their reserves, which means credit conditions might become excessively easy, impacting broader monetary aggregates and perhaps increasing inflation (Peersman, 2014). Two broad strategic approaches have been proposed¹³⁶ to deal with the exit from balance sheet measures. The first strategy entails selling off financial assets that were purchased during the crisis and thereby flushing the economy with liquidity. The second entails the maintenance of reserves at their current level (or perhaps slightly below), while increasing the policy rate through the usage of interest on reserves.

9.2.1.1 Shrinking the Balance Sheet ¹³⁷ In order to pursue price stability and conventional monetary policy instruments, central banks will have to consider the possibility of withdrawing liquidity extended during the crisis. In other words, they will want to return to a ‘normal’ balance sheet, before regaining control over their policy instrument. Historically, the size of the Fed’s balance sheet, for example, is around 6% of GDP, as opposed to the current 26% (Ihrig and Meade, 2015). Rapid reduction in the size of the balance sheet to return to these relatively low pre-crisis levels seems improbable and unrealistic, given how long it took to accumulate these assets (Kliesen, 2013). However, as discussed in the previous section, if the size of the balance sheet remains significantly elevated, the increase in the interest rate could hold problems with regard to remittances to the Treasury (Kliesen, 2013).

Furthermore, reducing the assets on the balance sheet is usually relatively straightforward, with the central bank conducting open market operations, trading Treasuries for reserves. However, in an attempt to remove toxic assets from the balance sheets of financial institutions, several central banks have traded illiquid assets for Treasuries. This has changed the composition of central banks’ balance sheets to include a large volume of risky assets, such as MBS. If the market is not ready to accept the return of these assets, it might distort financial market functioning. Exiting from unconventional policies could lead to capital gains or losses, depending on the relative value of the securities sold (Bernanke, 2010). In the case of the Fed, they have suggested holding MBS and related securities until maturity. However, this significantly increases the time taken to normalise the balance sheet, with the average maturity of the Fed’s asset portfolio calculated to be around 10.4 years (Williamson, 2015).

Clear communication with respect to exit strategy is important if central banks want to reduce their ‘footprint’ in money markets (Frost et al., 2015). Distortions could arise in certain market

¹³⁶There are technically more approaches, but they generally tend to fall within these two categories.

¹³⁷The original idea was to call this section “Honey, I Shrunk the Balance Sheet!” Cooler heads prevailed.

segments if the central bank intervenes for too long. Continued provision of liquidity to certain sectors translates into an increased role in financial intermediation on the part of the central bank, which could potentially “reshape the financial industry over time in ways that are difficult to anticipate in advance” (Ihrig and Meade, 2015). The possibility of cheap money without the possibility of an exit in that segment of the market may result in private sector agents staying away, preventing a return to normal in those markets (Plosser, 2009).

9.2.1.2 Interest on Excess Reserves (IOER) Due to the increase in the liabilities of the central bank, commensurate with the increase in assets, this translates to an increase in the monetary base. As Milton Friedman (1963) argues, if “high powered” (i.e monetary base) is permanently elevated, it will eventually lead to a higher price level¹³⁸. In such a case the central bank is tasked with eliminating excess liquidity or faces the consequence of increased inflation expectations (Peersman, 2014). However, using interest on reserves could potentially dampen the effects associated with increased liabilities, as banks will store some of their reserves with the central bank. Although implementing interest on reserves appears to be a new idea, it could be viewed as a reformulation of the ‘Friedman rule’, which tries to eliminate social inefficiencies associated with positive nominal interest rates (Friedman, 1969).

This rule, concerning the optimum quantity of money, is often interpreted to mean that the nominal interest rate should be set to zero at all times. However, the efficiency condition of the Friedman rule seeks to eliminate the interest rate differential between the opportunity cost of holding money and the cost of creating additional money (Chari, 2010). Applying this rule when interest paid on reserves is not factored into the equation means that the nominal interest rate needs to be set to zero, because the central bank creates money in a virtually costless manner. In the case where the bank can pay interest on reserves the efficiency condition adapts to allow for a positive nominal interest rate equal to the interest on reserves to be set (Cúrdia and Woodford, 2011). In other words, it is through interest on reserves that the policy rate can be increased (through a *de facto* increase of the interest rate floor), without having to draw down the central bank balance sheet (Woodford, 2012). In the case where central banks do not pay interest on reserves, they might need to unwind their balance sheet completely before they can conduct increases in the short-run nominal policy rate.

One concern raised about the usage of interest on reserves is that central banks and financial markets alike have no experience with it. Communicating policy objectives might be difficult and lead to uncertainty, which could generate volatility in the stock of reserves (Chari, 2010). In addition, while paying interest on reserves allows the central bank to change the level of

¹³⁸A phrase often used to describe this situation, is that “too many dollars chase after too few goods”

reserves independently from the interest rate, these changes outside of interest rate movements might be misinterpreted by financial institutions as signalling a certain stance of policy that contradicts the movement in the conventional instrument (Chari, 2010).

In addition to the outright sales of financial assets, as previously discussed, there are a few more ways in which central banks can avoid the potential volatility involved with issuing interest on excess reserves. However, I discuss only the two most popular options¹³⁹. First, mopping up excess liquidity could be done by establishing a depository institution at the central bank that allows customers access to term deposits. Financial institutions would then be able to trade their interest-bearing reserves for more attractively priced deposits that are held at the central bank for different agreed-upon periods of time (i.e. three months, six months, and so forth). This would mean that the central bank offers a service whereby it transforms reserves into short-term deposits (Chari, 2010). As deposits are held at the bank for longer time periods, this would avoid the volatility associated with interest paid on reserves. However, this strategy carries the potential for interest rate and rollover risk.

Second, reverse repurchase agreements (RRPs)¹⁴⁰ as supplementary tool has been suggested (Frost et al., 2015). These RRP are similar to normal open market operations, but instead of injecting liquidity into the economy through the purchase of Treasuries (or other assets), the central bank withdraws reserves through the sale of assets on its balance sheet (Labonte, 2015). However, the creation of a RRP facility that allows (potentially unlimited) access to safe, short-term assets carries some risks. In the short run, a potential drawback is that during periods of financial stress there might be a large movement to purchase central bank securities (a flight to quality), shifting liquidity away from financial and nonfinancial institutions and thereby crowding out private spending (Ihrig and Meade, 2015). In the longer run, a large RRP facility poses the same problem as that of normal unwinding of the balance sheet, with the central bank potentially exerting influence on market segments, if the liquidity withdrawal is great enough¹⁴¹.

¹³⁹Besides the two options discussed, central banks could increase the reserve requirement, which forces banks to hold a portion of their reserves as deposits (Labonte, 2015). Central banks could also adopt term reverse purchase agreements, which are a longer term version of the overnight reverse repos discussed in this section (Ihrig and Meade, 2015).

¹⁴⁰Repurchase agreements can be viewed as collateralised loans. It is an agreement between two parties to purchase and then repurchase assets at a specific price and date. Calculating the difference in price between the sale and resale determines the interest rate (cost) of the transaction (Labonte, 2015).

¹⁴¹There is disagreement in the literature about the influence exerted on financial markets as a result of Fed intervention. It is argued that if markets are not highly segmented that the relative contribution of the Fed's purchases will be a drop in the ocean, with economic activity in asset markets being too great for the central bank to make a difference. However, if market segmentation is significant, the central bank might be able to influence that segment. However, there is little consensus in the literature as to the degree of market segmentation, with precise definitions difficult to obtain (Chen et al., 2012a).

This solution seems to have gained some traction in the US. In 2014 the Fed announced that, as part of their normalisation approach, they would engage in these RRP's once the interest rate was increased¹⁴². With the interest rate increase in December 2015, the Fed started full-scale implementation of RRP agreements as part of its Policy Normalization Principles and Plans (Ihrig and Meade, 2015). The next section discusses, in more detail, the approach of the Fed, with specific reference to RRP's.

9.2.2 Normalisation at the Fed

Interest paid on reserves is a crucial component in both corridor and floor regimes, but the discussion on its usage has only taken hold that the Fed has adopted it as part of its normalisation strategy. While the Fed has legally been able to implement the policy tool since 2008, it has not been fully utilised. It is only recently, in 2014, that the FOMC indicated that this would be key to monetary policy normalisation, utilising it as an interest rate floor to accompany the increase in the policy rate (Ihrig and Meade, 2015). In addition, the Fed has introduced supplementary tools, such as reverse repurchase agreements to introduce greater control over the federal funds rate (Frost et al., 2015).

9.2.2.1 Reverse Repurchase Agreements One part of the conversation that has not been fleshed out until now, is the mechanism and design of the reverse repurchase agreement. The rest of this section is devoted to explaining its qualities and potential uses. As stated before, RRP's are a lending agreement between the central bank and a relevant counterparty. However, there are key differences between RRP's used currently by the Fed and the repurchase agreements conducted before the crisis (Ihrig and Meade, 2015).

First, overnight RRP's are offered at an "offering rate" announced by the central bank before agreements are structured. Eligible counterparties have time to decide - by comparing this rate to comparable market rates - whether they would like to bid. Initially the Fed accepted a fixed-rate, full-allotment structure (similar to that of the ECB) on these RRP's, but this was replaced by the fixed-rate capped-allotment structure (Frost et al., 2015). With FRFA, the amount of liquidity withdrawn is only limited by the size of the assets on the balance sheet of the central bank. However, this carries the risk, as previously stated, of a flight to quality in times of financial stress. This led the Fed to the auction model, where a cap is placed on how

¹⁴²In fact, RRP's were first suggested to the FOMC in July 2013 and have been used in an experimental fashion since September 2013, with several variations of overnight RRP operations conducted to determine the effect on short-term interest rates (Frost et al., 2015).

much an individual institution can bid, as well as on the overall size of the operation (Ihrig and Meade, 2015). At the time of writing the individual cap was set at \$30 billion, while the aggregate limit was \$300 billion¹⁴³.

Second, one of the observed anomalies in adopting the IOER framework was that the effective overnight federal funds rate often moved below the IOER, as seen in Figure 12. In theory this is not supposed to be possible, as in a perfectly competitive market without bank balance sheet costs, any difference between the money market rate and the IOER is subject to arbitrage (Anderson and Huther, 2016). While many nonbank institutions (thought of as lenders / suppliers of reserves) such as money market funds and government-sponsored enterprises, are “statutorily prohibited from earning IOER”, it was believed that arbitrage profits generated would be enough to steer market rates toward the IOER (Anderson and Huther, 2016). This means that depository institutions (the borrowers of reserves) with access to IOER would borrow funds from nonbanks and then deposit them at the central bank to make a profit. This process would lift the short-term market rates to equalise the IOER.

It appears that depository institutions are subject to several frictions¹⁴⁴ that have prevented arbitrage from being complete. In this setting, nonbanks awash with excess liquidity were willing to deposit their funds with depository institutions at a level below the IOER (Armenter and Lester, 2015). For arbitrage to occur, depository institutions must expand their balance sheets to accommodate the increase in reserves, which carries certain procedural fees and costs¹⁴⁵. As stated by Potter (2015), balance sheet expansion created “frictions that have made IOER act more like a magnet that pulls up short-term interest rates than a firm floor beneath them”.

The Fed established an RRP facility in order to “supplement the magnetic pull of changes in the IOER rate” (Potter, 2015). One of the unique properties of the RRP is that the central bank can decide which institutions are eligible to take part in these operations. Potentially included in this set of market participants are nonbanks¹⁴⁶ that are active in short-term money markets. In this sense, the eligible counterparties for RRP can exceed those that can hold IOERs.

¹⁴³The results of the bids can be found at <http://www.newyorkfed.org/markets/omo/dmm/temp.cfm>.

¹⁴⁴These frictions include balance sheet costs associated with accepting deposits and credit limits on cash lenders. See the discussion in Martin et al. (2013), Potter (2015) and Armenter and Lester (2015). In an attempt to formally show this behaviour, the paper by Armenter and Lester (2015) construct a model in which markets are not perfectly competitive, with depository institutions subject to search frictions.

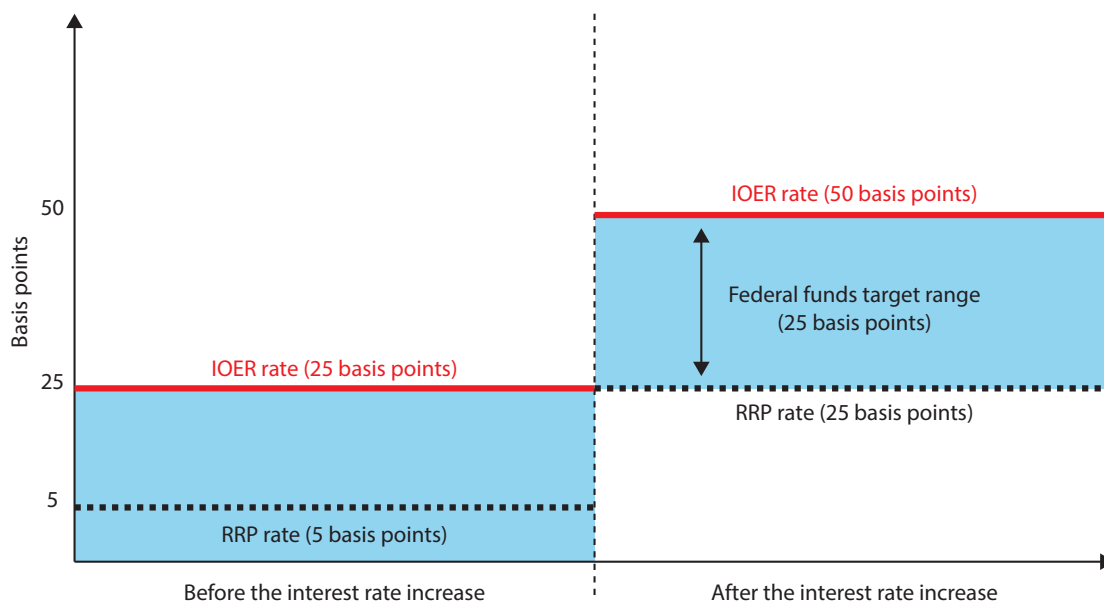
¹⁴⁵Fees payable to the Federal Deposit Insurance Corporation (FDIC) based on total assets net equity, liquidity requirements and costs associated with increasing bank capital and (Frost et al., 2015). In addition with Basel III there are likely to be leverage ratios and further inclusion of rules from the Fed

¹⁴⁶The Fed currently has 164 counterparties for RRP. These include primary dealers, banks, money market funds and government sponsored enterprises (Frost et al., 2015). A list of counterparties is provided at www.ny.frb.org/markets/expanded_counterparties.html

This widening of counterparties is useful, because the central bank can now set the interest rate on RRP for financial and nonfinancial institutions without access to IOER. Setting the RRP slightly below the IOER allows the Fed to purchase reserves from nonbanks, and removes the incentive to lend funds to other market participants at below the rate they receive at the Fed (Ihrig and Meade, 2015). Nonbanks prefer to deal with the central bank, as this is a riskless secured loan, as opposed to the unsecured loans in over-the-counter markets (Rosengren, 2016). Setting the overnight RRP interest rate and then accepting reserves from eligible counterparties should help increase competitiveness in money markets and thereby firm the floor beneath the federal funds target (Ihrig and Meade, 2015). In principal, market participants in the federal funds market will not have any incentive to lend below the overnight RRP, which means it acts as a supplement to the IOER in controlling the federal funds rate (Frost et al., 2015).

Testing done at the Fed as to the effectiveness of RRP has yielded positive results. In particular, overnight RRP have been effective in firming the short-term interest rate floor. One of the design features which I haven't mentioned is the potential to control the band between RRP and the IOER, which helps keep the federal funds rate under control. This is best explained with an example, which is demonstrated in the next section.

Figure 11: The Fed's exit strategy

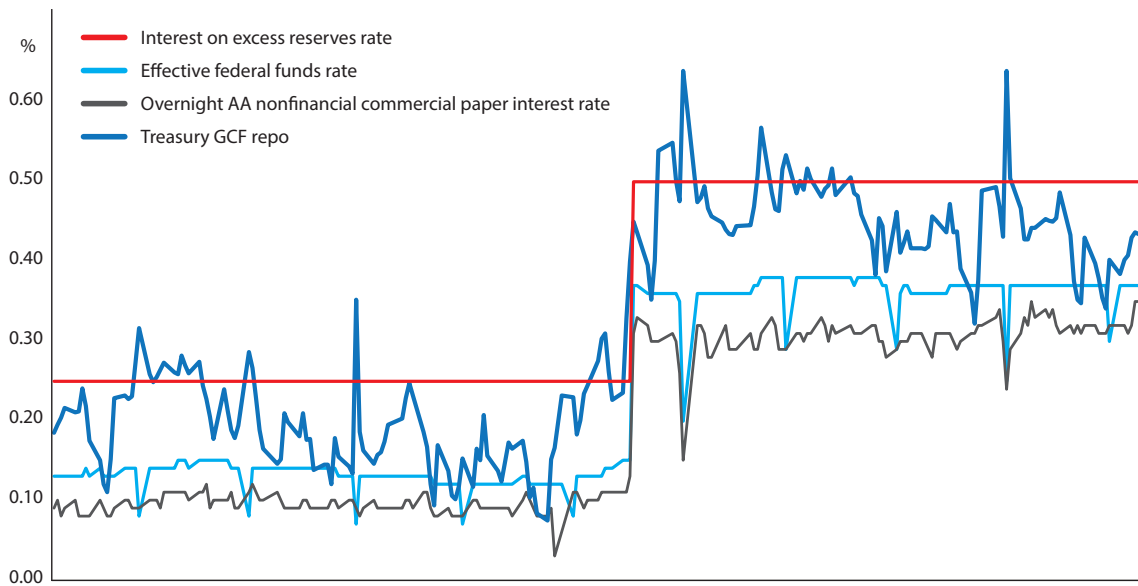


Source: Ihrig (2015)

IOER = Interest on excess reserves; RRP = Reverse repurchase agreements

9.2.2.2 Practical Example In order to provide a practical example and expand on the mechanisms used, this section provides a look at how the Fed has implemented its normalisation

Figure 12: Interest on excess reserves and selected overnight interest rates



Source: St Louis Federal Reserve Bank

strategy. In 2015 the economic outlook - in terms of employment, output and inflation - had improved to such an extent that the Federal Open Market Committee decided it was time to implement monetary tightening, through an increase of the federal funds rate by 25 basis points¹⁴⁷. In addition, a band of 25 basis points was established around the target. As indicated in Figure 11, the hybrid regime of the Fed now has the following properties.

First, the interest on excess reserves, which is currently set at 25 basis points above zero, forms a soft floor on the policy rate. Second, the federal funds rate target is set at the top of the target band, equal to the IOER. Third, the introduction of the overnight reverse repurchase rate at 25 basis points below the IOER. With this setup, one expects the effective federal funds rate, and other short-term markets, to be contained within the band established as the result of arbitrage (Ihrig and Meade, 2015).

From the data representation in Figure 12 one can see this realised. The overnight nonfinancial commercial paper interest rate provides an idea of the interest rates on nonfinancial firms without access to the IOER facilities of the central bank. For these nonfinancial firms the market rate is close to the RRP rate. On the other hand, the Treasury general collateral financing (GCF) repo rate represents a market related interest rate that takes only a few nonbank institutions into account. This rate better reflects the notion that market rates move in line with the IOER rate, as opposed to the narrative suggested by the effective federal funds rate.

¹⁴⁷The targeted federal funds rate is provided at <http://www.federalreserve.gov/monetarypolicy/openmarket.html>

There are several undesirable effects from policy normalisation. In terms of the domestic economy, unwinding of the balance sheet and using tools like RRP can lead to an increased footprint in financial markets, disrupting financial intermediation. However, policymakers should not only be concerned with secondary effects in their own markets; they should consider that policies implemented and disbanded could have potential international spillovers. The next section discusses the potential impact that policy initiatives can have on the rest of the world.

9.3 International Spillover Effects

The explosive growth of the balance sheets of advanced economies has led to a rapid increase in global liquidity (Tillmann, 2016). Owing to the increasing interconnectedness of global economies a significant portion of this liquidity spilled over to emerging markets. The magnitude of the liquidity shock leads one to believe that these spillover effects could be potentially severe. Brazil's president, Dilma Rousseff, referred to the expansionary policies of advanced economies as creating a "monetary tsunami"¹⁴⁸. Although some emerging economies have profited from these unconventional policies, the reality is that it leaves a large portion of them exposed to market volatility and current account reversals. Spillovers from balance sheet policies have been a source of lively debate between researchers and policymakers, and in this section I frame some of the pertinent arguments.

While many countries have experienced a substantial boom in economic activity as the result of these policy actions, it has often come at the cost of severe disruptions to several key markets. Financial markets, in particular, are prone to distortion as a consequence of increased risk taking on the part of both foreign and domestic investors. This is illustrated by the portfolio balance channel where purchases of long-duration securities cause a substitution toward higher yielding assets. The search-for-yield by investors from developed economies often leads them to direct their capital flows to emerging markets, where returns are relatively higher (Banerjee and Basu, 2015).

Inflows of capital typically are welcomed, in moderation. However, large inflows can be quite volatile and create temporary stock market booms¹⁴⁹. In addition, they tend to drive up prices of certain assets artificially, leading to asset bubbles and lower yields in the affected countries (Morais et al., 2015). As a result, looser financial conditions in the country receiving capital flows can develop, which promotes risk seeking by domestic investors (Lavigne et al., 2014).

¹⁴⁸Which is also the title of the article by Fratzscher et al. (2012).

¹⁴⁹In an interesting quote by Reinhart and Reinhart (2008), they state that "bonanzas are no blessing for advanced or emerging market economies. In the case of the latter, capital inflow bonanzas are associated with a higher likelihood of economic crises (debt defaults, banking, inflation and currency crashes)".

It has been argued that the exchange rate channel also has an important role to play (Park et al., 2015). Capital outflows could cause a depreciation in the currency of the country implementing the policy. This could improve the competitiveness of the advanced economy by making its exports relatively cheaper. On the other hand, asset purchases would mean greater demand for emerging market products, potentially offsetting the effect of the appreciation (Lavigne et al., 2014). The next section provides an overview of the empirical evidence from studies on international spillovers.

9.3.1 Empirical Evidence

The idea of spillovers across financial markets is not a new one. The literature on monetary spillovers is present in the work of David Hume in 1742, while early modelling of these phenomena dates back to the contributions of Fleming (1962) and Mundell (1963). The reason for the intense study of spillovers and capital flows is their ability to generate crises. Since the Second World War, there have been several crises that have been initiated by strong capital inflows and then accompanied by sudden reversals. Examples of these are the tequila crisis in Mexico in 1994-95, the East Asian financial crisis in 1997, the Russian default in 1998, the Argentine crisis in 2001 and the South American economic crisis of 2002 (Powell, 2013). However, empirical research on the topic of international spillovers in the case of the recent financial crisis is still limited. Researchers have been able to determine that the magnitude and speed at which the policies of advanced economies are being transmitted to emerging markets is unprecedented, with the relative impact of channels of transmission not known (Ghosh and Sagar, 2016)¹⁵⁰.

At this stage almost all of the studies focus on the cross-border impact of the US large-scale asset purchases. Two strands of research on the effects of QE have emerged. First, a literature has developed on studying the impact of the announcement of QE by utilising high frequency data; this usually entails the use of event study methodology. Second, several studies consider the broader macroeconomic impact of QE with monthly and quarterly data. Econometric techniques are normally variants of the VAR methodology, and are often applied to panel data. I discuss the empirical evidence from each strand in turn.

9.3.1.1 High-Frequency Data Using intraday data on futures prices Glick and Leduc (2013) identify the surprise component from the announcement of QE, and found that it caused a

¹⁵⁰By this, I mean that the relative strength of the channels is not known. The effect of the spillover could be positive or negative depending on which effect dominates. Some of the relevant channels are the exchange rate channel, the domestic demand channel and foreign financial conditions.

significant depreciation of the US dollar in relation to other major currencies. They argue, however, that the effect is not dissimilar to that of a conventional monetary policy shock of equal size. However, in a later study, Glick and Leduc (2014) amend their result, using a new approach to identifying policy surprises. They found that monetary easing through balance sheet expansion has roughly three times the impact as that of an equivalent interest rate shock¹⁵¹. In other words, balance sheet policy has more “bang per policy surprise on the value of the dollar” than previously (Glick and Leduc, 2014).

Fratzscher et al. (2013) look at the impact of QE1 and QE2 (as implemented by the Fed) on international financial markets, looking specifically at the effect on interest and exchange rates. A unique dataset of high-frequency portfolio flows allowed them to track capital injections across a wide range of countries. They found that QE1 caused an appreciation of US currency, with large-scale withdrawals of capital from emerging markets, which resulted in increased equity and bond prices in the US. However, QE2 seemingly caused a depreciation of the US dollar and an outflow of capital to EMEs.

Bauer and Neely (2014) make use of event studies and dynamic term-structure models to evaluate the contribution of the signalling and portfolio balance channels in affecting international bond yields. They found that the relative impact on bond yields from LSAPs is similar to the movement experienced as a result of conventional monetary policy surprises. Neely (2015) looked at the impact of QE in developed economies, focusing on the cross-border financial market impact. He used an event-study approach in conjunction with a portfolio balance model and found a substantial impact on international markets, decreasing yield spreads across all countries considered. In a similar vein, the work of Rogers et al. (2014) focused on the effect of unconventional policies on asset prices (using daily and intradaily data) in a selection of developed economies. They found that there are significant, but asymmetric, cross-country spillovers where the “effects of US monetary policy shocks on non-US yields are larger than the other way round” (Rogers et al., 2014).

9.3.1.2 Lower-Frequency and Panel Data Chen et al. (2012b) used a global VAR to determine the financial market impact of QE. They found that QE increased global asset prices across a wide range of assets, such as sovereign and corporate bond yields. According to this study, emerging markets, in particular, experienced increased capital flows, greater credit extension and inflationary pressure. Lim et al. (2014) used a panel model for capital flows. They found significant spillover effects to developing countries through the portfolio balance, signalling

¹⁵¹Naturally, this is a comparison to the period before the ZLB was reached, as that was when the last shock was applied to conventional policy instruments.

and liquidity channels from the US LSAP programs. Bowman et al. (2015) used a VAR, and their results indicate that the effect of QE has not outsized that of normal monetary easing. In order to determine the relative contribution of quantitative easing, Alpanda and Kabaca (2015) developed a two-country DSGE model. They found that the effect of QE is larger than that from conventional monetary policy, with increased asset prices in the rest of the world.

A newly released article by Tillmann (2016) tries to quantify the effect of QE on emerging market economies. He sets up a Qual VAR¹⁵², that inputs information from QE announcements into a traditional VAR setting. Tillmann (2016) finds that QE has significantly impacted emerging economies, specifically along the dimensions of “capital flows, exchange rates, equity prices and bond prices”. Using a global VECM, Chen et al. (2015) also found that QE significantly affected emerging markets, contributing to the overheating, but also recovery, of several economies after the financial crisis. They believe that unintended international spillovers from balance sheet policies could be an important source of global financial instability in future, which leads us to our discussion on tapering.

9.3.2 Tapering

In my discussion on exit strategies, the idea of unwinding balance sheet measures was investigated. Recently, concerns have been vocalised, by emerging market economies such as India, Turkey, Brazil, Indonesia and South Africa, about the phasing out of these balance sheet measures (Tillmann, 2016). As evidenced by the ‘taper tantrum’ of 2013, balance sheet policies can have a large effect on international markets in highly globalised markets (Aizenman et al., 2014). As a result of this announcement, sovereign yields in many emerging market economies increased, stock market indices registered large drops, and currencies depreciated (Bowman et al., 2015). In addition, sharp reversals of capital flows were recorded in several Asian and Latin American countries (Nechio, 2014).

Contractionary policy in advanced economies, which signals the transition to higher global rates, could mean a more pervasive reversal of capital flows (Mishra et al., 2014). Reversals could have a substantial impact on emerging markets, causing sudden stops when capital returns to advanced economies. While external factors are important for spillover effects, one also has to consider internal domestic macroeconomic fundamentals¹⁵³ (Nechio, 2014). Although it is possible for countries with strong fundamentals to be affected by spillovers, the general consensus is that those countries have a greater tendency to weather volatile capital movements,

¹⁵²As first utilised in Dueker (2005).

¹⁵³Usually determined by the health of the fiscal and current account.

as agreed by Ahmed and Zlate (2013), Aizenman et al. (2014), Sahay et al. (2014), Rai and Suchanek (2014) and Basu et al. (2014).

Conflicting evidence is reported with respect to the effect of tapering on countries with ‘deeper’ financial markets. Eichengreen and Gupta (2015) argue that countries with greater ‘financial depth’ are exposed to large capital movements, due to the relative ease with which flows can be injected and withdrawn. On the other hand, Aizenman et al. (2014) find that countries with more sophisticated financial markets were better positioned. They attribute this, in part, to the fact that these countries normally have stricter macroprudential policies with respect to capital flows.

The lesson one can draw from this is that in order to overcome problems of the exit from balance sheet expansion, there needs to be greater international monetary policy coordination. Advanced economies need to communicate their exit strategies clearly, to prevent market overreaction. Emerging markets can insulate themselves from shocks, by adhering to stricter macroprudential rules with regard to credit flows. In addition, weaker economies need to improve the position of their fiscal and current accounts, as having stronger fundamentals could provide a buffer against the greatest shocks to capital flow.

Conclusion

As frequently mentioned, the financial crisis was a widespread disaster that resulted in an untold disruption of the world economy. Befitting the size of this event, authorities responded with policy actions of an unprecedented magnitude. Owing to the degree of monetary intervention, it seems prudent to reflect on these policy actions. Academic discussion as to the potential policy impact and transmission is a useful starting point, but it needs to be consolidated with appropriate empirical evidence. Success of policies implemented, and the proposed channels of transmission, are presented in this section. The consensus is that balance sheet policies were successful in avoiding even larger disturbances to economic activity, and in some cases restored function to failing markets. There is still disagreement as to the specific channels through which balance sheet policies operated, but their overall success is consented.

From this discussion it is evident that the usage of central bank balance sheets will become the norm in many advanced economies experiencing financial distress. Adopting these policies when financial markets are dysfunctional, and traditional policy tools have outgrown their usefulness, is easy to motivate and considered a necessary evil. However, it is uncertain to what

extent these measures will be used in normal times. Concerning normal times, the last part is a discussion on the broader implications, such as international spillovers and central bank independence. Most importantly it includes a discussion on how policy is to move forward with inflated balance sheets.

In a recent article Ihrig and Meade (2015) state that the new implementation of monetary policy with interest on excess reserves and reverse repurchase agreements, as implemented by the Fed, means that the way we understand and teach economics to future generations will fundamentally change.

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