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Abstract

We assess recent developments in monetary policy practice following the financial crisis drawing on papers from a specially convened conference in March 2010. In particular, we consider why central banks throughout the world have injected substantial quantities of liquidity into the financial system and seen their balance sheets expand to multiples of GDP. We outline the rationale for balance sheet operations: (i) portfolio balance of the non-bank financial sector; (ii) an offset for the zero bound; (iii) signalling mechanism about medium term inflation expectations and (iv) the alleviation of the government's budget constraint. We briefly outline the recent experience with QE and draw a distinction between liquidity and macroeconomic stabilisation operations.

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1 Introduction

The chapters in this volume are the outcome of a conference held in Cambridge in March 2010. The title of the conference was "New Instruments of Monetary Policy". The purpose of the conference was to bring together economists from academia, financial markets and central banks to discuss some of the challenges that arose from both the financial crisis itself and the response to that crisis. Many of the assumptions that

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underpin mainstream (core) macroeconomic models have been challenged as a result of the traumatic events of the last 3 years. In particular it became clear that the modern, micro-founded, form of macroeconomic model failed to allow adequately for the financial sector.[1]

This failure, in part, reflected the belief that one could safely separate issues concerned with financial stability from the conduct of macroeconomic policy: macroeconomic policy and, in particular, monetary policy, should be devoted to the stabilisation of inflation and output, and the short-term nominal interest rate used as the instrument of policy. Although it is well known that such a policy will be problematic when nominal interest rates are close to the zero interest rate floor, in practice it seemed that policy was successful in keeping the economy away from this region. The long road to price stability in the UK, led down a number of cul-de-sacs ranging from: monetary targets; shadow exchange rate targets; an explicit exchange rate target and then to inflation targeting, ultimately with operational central bank independence. Many commentators suspected that monetary policy operating procedures might have arrived at their final destination.

However the exceptional circumstances of the financial crisis - which first manifested itself as a financial intermediary liquidity drought[2] - and the need for loose monetary policy, the zero interest rate floor became the over-riding constraint acting on monetary policy makers. Prior to the crisis, it had been broadly expected that the economy would operate at the zero lower bound for only around 2% of the time at 2% inflation targets.[3] But the proximity of the zero lower bound constraint meant that *so-called* unconventional or *new* monetary policies had to be adopted. In 2004 Bernanke, Reinhart and Sack set out three types of response to the zero interest rate floor. First, a communication strategy must be used to influence expectations what interest rates and price levels will be in the future; secondly, an expansion in the size of the Central Bank's balance sheet and finally direct use of the composition of the Central Bank's balance sheet to change relative yields. These three principles essentially encapsulate how Central Banks around the world responded in different ways to the crisis.

1.1 Macroeconomics and the Crisis

The financial crisis has pushed the perennial questions of money and banking back to the fore of macroeconomic analysis. Until recently, it was widely agreed[4] that although the stock of money had a role to play, in practice it could be ignored as long as we used short-term nominal interest rates as the instrument of policy because money and other

[1] This conference is the first in a series of conferences convened to think about the linkages between macroeconomics, finance and policymaking after the financial crisis.

[2] See Gale (2010) and Gianonne *et al* (2010) in this volume on this point.

[3] See, for example, Bean (2003) makes this point. Naturally a higher inflation taget changes the duration downwards.

[4] At least outside of Frankfurt.

credit markets would clear at the given policy rate. Allied to this view was the belief that shocks to financial markets should not especially matter for the conduct of monetary policy when you are using the short interest rate as the main instrument over and above any impact they will have on the forecast output gap.[5] But during the crisis, at least with interest rates near the lower zero bound, market interest rates became endogenous to the size or composition of the central bank balance sheet.

It has also become increasingly difficult not to agree with the proposition that financial regulation, fiscal policy and, even the objectives of overseas policymakers may constrain the actions of monetary policy makers. Indeed, in his June 2010 Mansion House speech, the Governor of the Bank of England welcomed whole heartedly the Chancellor's plan to re-combine monetary and financial policy: "the Bank (will) take on (responsibilities) in respect of micro prudential regulation and macro prudential control of the balance sheets of the financial system as a whole. I welcome those new responsibilities. Monetary stability and financial stability are two sides of the same coin. During the crisis the former was threatened by the failure to secure the latter". Indeed prior to the financial crisis a form of separation or dichotomy was in place, whereby monetary policy concentrated on inflation, and developments on finance or credit were treated as essentially a matter of microeconomic regulation.

From the imaginary vantage point of the first few years of the 21st century the collapse of the separation principle would seem rather surprising. The new monetary policy consensus that emerged appeared to have solved many of the technical problems of monetary policy management. A representative view from this era, though written with circumspection, is that by Ben Bernanke (2004), who argued that: "Few disagree that monetary policy has played a large part in stabilizing inflation, and so the fact that output volatility has declined in parallel with inflation volatility, both in the United States and abroad, suggests that monetary policy may have helped moderate the variability of output as well...my view is that improvements in monetary policy, though certainly not the only factor, have probably been an important source of the Great Moderation."[6] He suggests several reasons for this: (i) low and stable inflation outcomes promoting a more stable economic structure, (ii) better monetary policy reducing the size and distribution from which measured shocks are drawn and (iii) variable inflation expectations stop becoming an exogenous driver of macroeconomic instability. But the most important was arguably understanding the limitations of monetary policy. Bound by severe information constraints about the correct model and the current state of the economy, monetary policy concentrated on gauging the correct current level and prospective path for short-term interest rates in order to stabilise inflation and aggregate demand over the medium term. There was a general acceptance that a simple rule was likely to dominate a fully

[5] We will discuss Poole's analysis of this question in Section 2.

[6] In a speech to the Eastern Economic Association, Washington, DC February 20, 2004, The Great Moderation - http://www.federalreserve.gov/boarddocs/speeches/2004/20040220/

blown optimal rule, which was, in any case, always predicated on a particular model and subject to time inconsistency.

From an older perspective the *Art of Central Banking* predated the *Science of Monetary Policy* and tended to define central banking not so much in term of a narrow price stability but also in terms of objectives that might now be termed financial policy and involved policies to safeguard the continuing health of the financial system.[7] This art developed as a response to both the multiplicity of roles 'grabbed' by a developing central bank but also fundamentally in response to crises. Bagehot, Lombard Street, (1873) famously outlined the principles of central banking in a crisis: (i) the central bank ought to lend freely at a high rate of interest to borrowers with good collateral; (ii) the value of the assets should be somewhere between panic and pre-panic prices and (iii) institutions with poor collateral should be allowed to fail. The general understanding of these principles has been associated with the avoidance of banking panics in England since the Overend and Gurney crisis of 1866, which was the previous example of a bank run in the UK until Northern Rock in 2007. The relevance of Bagehot's principles for the current crisis has recently been acknowledged by among others Mervyn King at the Bank of England (King, 2010) and by Brian Madigan at the Federal Reserve Board (Madigan, 2009).

Whilst short-term liquidity support, of varying kinds, was ultimately offered by all major central banks following the August 2007 freeze in interbank markets, another issue emerged shortly thereafter: how to deal with the zero lower bound on interest rates. In each case, the response has been to increase the size of the central bank balance sheet.[8] The basic idea here has borrowed from an older literature in which "the size, composition and risk profile (Borio and Disyatat, 2009. p5)" is used to control financial conditions more generally. Because of imperfect substitutability across financial claims and a degree of market segmentation, a central bank that uses its balance sheet to alter the structure of private sector balance sheets can influence financial prices (Tobin 1958) and change the relative yields on assets (Brainard and Tobin, 1968). In this sense, balance sheet operations are really forms of extended open market operations with the objective of altering longer-term interest rates to an enduring extent.

1.2 Non-standard Monetary Policies

In this volume we outline some tentative answers from macroeconomists. The papers consider the theoretical case for bolstering the liquidity and capital holdings of financial intermediaries in line with the recently published Basel III recommendations.[9] A new

[7] Compare the work of R. G. Hawtrey (1934) and R. Clarida, M. Gertler and S. Gilchrist (1999).

[8] This leads to the question of whether balance sheet operations and commercial bank reserve policies are independent of the short term interest rate or simply complementary to the zero lower bound constraint.

[9] See the pages of the BIS at http://www.bis.org/bcbs/basel3.htm

generation of macroeconomic models suggest that financial frictions matter substantially in explaining business cycle fluctuations since they not only amplify the impact of a typical range of shocks but also can contribute directly to fluctuations. The papers also throw light on the implications of relaxing liquidity premia in a variety of newly developed macroeconomic models. Typically, the size of the central bank balance sheet has to be expanded considerably in order to offset the lower bound interest rate constraint. Two papers from central bank-based economists show that the impact of balance sheet policies on both long-term bond prices and on components of aggregate demand are far from insignificant, if carried out as part of a credible strategy to combat the zero bound. Finally, the UK's policy of quantitative easing is explained and some criticism of the current state of models offered.

Let us start with a development of the criticism of baseline New Keynesian macroeconomics, that monetary policy with an explicit (or implicit) inflation target could not adequately capture information from money, asset prices and the accumulation of debt about medium term macroeconomic disequilibria.

2 Directions Old and New

The long-run neutrality of money is a central plank of monetary policy making (Lucas, 1995). Although it is quite a simple matter to find long-run non-neutralities in many standard New Keynesian models, it is generally found that long-run non-neutralities should not be exploited as there is not clear enhancement in the welfare of the representative household.[10] Naturally though, perturbations in the money market will lead to temporary changes in the market clearing level of (overnight or short-term) policy rates and, because of various forms of informational uncertainty or indeed structural rigidity, will lead to temporary deviations in the expected real rate from its natural level and thus act on aggregate demand. The key question though is the extent to which shocks emanating from the money market can be stabilised by an interest rate rule or indeed whether an additional tool may required.[11]

In a seminal analysis of this question, Poole (1970), took a standard IS-LM framework and analysed the impact on output variance from setting either interest rates or the money supply in the presence of stochastic shocks to either or both of spending or money market equations. When shocks to financial markets dominate relative to shocks in the real part of the economy, the natural assignment is then broadly to use interest rates rather than the stock of money as the main policy instrument. But he also showed that, in general, neither instrument would necessarily stabilise the economy better then the other as it depended on the relative magnitude of shocks in these sectors and the sensitivity of output to these respective shocks. An often overlooked implication of his analysis was

[10] See Khan *et al* (2003) on this point.

[11] See Chadha *et al* (2008) and Curdia and Woodford (2010) on this point.

that in general some use of both instruments was likely to stabilise the output better than one instrument alone, a point to which we shall return, but one that is perhaps echoed by the experience of policy makers worldwide as they have had to augment interest rate tools by the expansion of the central bank balance sheet.

The Bank for International Settlements, from a disinterested position - as it does not actually have to set monetary policy - regularly expressed concern about what we might call a "worrying triplet". This triplet comprises high internal and external debt levels, high asset prices and rapidly growing broad money aggregates. White (2006) added to worries about whether it was sensible to partition monetary and financial issues with a further concern: the horizon over which policy sought to stabilise was also part of the problem. "...Central banks have put too much emphasis on achieving near term price stability (p.2)" at the expense of considering in detail what the implications may be for longer-run macroeconomic stability coming from the build-up in domestic and international 'imbalances'. Of course, central banks have explored the notion of flexible inflation targeting, whereby financial considerations may operate as an occasionally binding constraint which would, in principle extend or contract the horizon over which inflation would be brought back to target.[12]

Any direct discussion of a special role for financial intermediation leads to the reconsideration of the relevance of Bernanke and Blinder's 1988 model of credit and demand.[13] In comparison with the two asset world of the LM curve where there is simply a choice between money and bonds, if credit is not a perfect substitute for bonds then the quantity of loans and the external finance premium matters. In other words, spending will be affected by interest rates in the broader credit (or loan) markets and so the allocation of funds across narrow and broad money by financial institutions will matter for the level of aggregate demand.[14] This important point was mostly neglected in the great DSGE revolution of monetary policy making that took place over the subsequent two decades, in which the Modigliani-Miller theorem held continual sway, as issues of real economy structure and monetary policy strategy took centre stage with financial intermediation and monetary quantities having no special role to play over the short-term policy rate.

From the policy perspective the prosaic answer of the Bundesbank and, latterly, of the ECB is that money does indeed matter. For the former as an intermediate target of policy and for the latter as an indicator variabels for the pursuit of its inflation target. Where broad money growth that is associated closely with the growth in nominal expenditure and that timely and accurate analysis of monetary dynamics constitutes (arguably) the most important part of the central bank's information set. Indeed, the Governor of the Bank of England, in a paper written while he was Deputy Governor, Mervyn King (2002) argued that money is important because it is an imperfect substitute for a wide

[12] See Bean (2003).

[13] A version of which we develop in Section 2.1 below.

[14] In the next sub-section we develop a version of this model to help us understand QE.

variety of assets and so a change in its quantity will induce some rebalancing of financial portfolios and therefore will have an impact on nominal demand with both direct effects on real assets and indirect effects, as financial yields will change and so the yields from many financial assets may enter the broad money demand function. And with some prescience he argues that money may matter simply because it relaxes transaction costs and promotes liquidity, a point taken up by several papers in this volume.[15]

Using money, or at least central bank liabilities, as an additional instrument of monetary policy, reflects the need to augment interest rate policy at the zero bound or indeed simply to deal directly with a malfunctioning financial system. The switch from money endogenously clearing to a given path in interest rates to a world in which market interest rates respond to the size and composition of the central bank balance sheet is a clear divergence from recent practice. But as to whether the use of central bank liabilities can offset the shift in the supply curve for money and its counterparts too far to the left, which is the credit crunch, is but one issue. Actually the development of new instruments also fits very well into the game theoretic armory available for central bankers. This is because complementary instruments may well augment the signalling impact of both the current level of interest rates and the expected path of interest rates.[16] Note that one popular solution to the problem of controlling a forward-looking system of rational agents is to make it easier for those agents to forecast future policy and so condition their plans in line with the policymaker's objectives.[17] And so any strategy that is consistent with signalling a long period low policy rates may help reduce real rates over a longer horizon and so raise price level expectations. One such option, often discussed, would involve a commitment to a price level path over the long run, so that expectations would be formed of a positive inflation during any deflation and so drive down longer-term real interest rates.[18]

2.1 A Framework for Balance Sheet Operations e.g. QE

If we leave to one side the signalling effect through a communications strategy, we can think about the (fiscal and) portfolio channels within the context of simple equilibria for money and spending equations in the economy. The discussion of a special role for financial intermediation leads us to reconsider the relevance of credit in determining demand. In comparison with the two asset world of the LM curve where there is simply a choice between money and bonds, if credit is not a perfect substitute for bonds then the quantity of loans will matter for the determination of macroeconomic equilibrium. And so we can consider a simple model with money, bonds and loans:

[15] For example, see Driffill and Miller.

[16] Work by Gürkaynak *et al* (2005) suggests that the empirical impact of monetary policy on asset prices reflects both the the level of rates and the likely future path, or stance of policy.

[17] See Woodford (2003) on the timeless commitment technology of monetary policymakers.

[18] See Svensson, 2003, on this point.

$$L_t^d = y_t - \eta_1 (\rho_t - i_t), \tag{1}$$

where loan demand, L_t^d, is a function of the interest rate on bonds, i_t, the interest rate on loans, ρ_t, and the level of transactions, y_t and η_1 is an elasticity. The commercial bank balance sheet comprises: reserves, R_t, loans, L_t^s, and bonds, B_t, as assets and deposits, D_t, as liabilities. Without any loss of generality let us assume that reserves equal τD_t, a fraction, τ, of deposits, so that the bank balance sheet is as follows:

$$\begin{aligned} B_t + L_t^s + R_t &= D_t & (2)\\ B_t + L_t^s &= D_t (1 - \tau), & (3) \end{aligned}$$

and loans supply has the following form:

$$L_t^s = \eta_2 (\rho_t - i_t) + D_t (1 - \tau), \tag{4}$$

which is increasing in the premium of loans over bonds and deposits and decreasing in reserves. As before η_2 is an elasticity. Solving for clearing in the loans market:

$$\begin{aligned} y_t - \eta_1 (\rho_t - i_t) &= \eta_2 (\rho_t - i_t) + D_t (1 - \tau) \\ y_t &= (\eta_1 + \eta_2)(\rho_t - i_t) + D_t (1 - \tau) & (5)\\ \rho_t &= \frac{y_t - D_t (1 - \tau)}{(\eta_1 + \eta_2)} + i_t, & (6) \end{aligned}$$

which tells us that the excess of interest rates on loans over bonds increases in output and reserves and decreases in deposits and the elasticity of loans demand and supply. Now let us consider the deposit market, supply is given as follows:

$$D_t^s = \frac{1}{\tau} R_t,$$

and the demand for deposits is given by:

$$D_t^d = y_t - \eta_3 i_t, \tag{7}$$

which clears for:

$$y_t = \eta_3 i_t + \frac{1}{\tau} R_t \tag{8}$$

and gives the standard LM curve, but one in which increases in reserves push out the curve. The spending curve responds to both interest rates on bonds and to loans:

$$y_t = -\eta_4 \left(i_t + \rho_t \right) \tag{9}$$

which can be re-written as:

$$\begin{aligned} y_t &= -\eta_4 i_t - \eta_4 \left(\frac{y_t - D_t \left(1 - \tau \right)}{\left(\eta_1 + \eta_2 \right)} + i_t \right) \\ &= \frac{\eta_4}{\eta_1 + \eta_2 + \eta_4} \left[R_t \left(\frac{1}{\tau} - 1 \right) - 2 \left(\eta_1 + \eta_2 \right) i_t \right] \end{aligned} \tag{10}$$

so the spending equation will be negative in bond rates and shifted out by increases in reserves. Following Bernanke and Blinder (1988), we term this the CC curve. Figure 1 shows the impact of a balance sheet operation, such as quantitative easing, in this set-up. The swap of bonds outstanding for reserves, increases reserves and so pushes out the CC curve and the increase in reserves also acts to push out the LM curve. Although output will rise, the actual impact on bond rates will be ambiguous as it will depend on the impact of reserves on the money supply and the extent to which any easing in the external finance premium increases aggregate demand. If the former dominates the latter, interest rates will fall. If on the other hand, spending effects dominate then the latter would dominate. The early empirical results on the announcement effects of QE suggest that there has been more of a downward interest rate effect. It might very well be therefore that financial market participants have not transmitted the possible impact on spending down the asset price channel but it is still early days and the lagged effects of QE may imply higher interest rates as the economy is expected to recover.

2.2 There is little new under the sun

The recent focus on Quantitative Easing has led to comparisons with events in the past. Initially it was assumed that QE was first used in Japan in 2001.[19] However, Anderson (2010) has drawn attention to events in the 1930s[20] when in all but name quantitative easing was used.

> During 1932, with congressional support, the Fed purchased approximately $1 billion in Treasury securities (half, however, was offset by a decrease in Treasury bills discounted at the Reserve Banks). At the end of 1932, short-term market rates hovered at 50 basis points or less. Quantitative easing continued during 1933-36. In early April 1933, Congress sought to prod

[19] For a detailed disection of QE in Japan, see Werner (2002).

[20] For a more detailed discussion see Metzler (2003).

> the Fed into further action by passing legislation that (i) permitted the Fed to purchase up to $3 billion in securities directly from the Treasury (direct purchases were not typically permitted) and, if the Fed did not, (ii) also authorized President Roosevelt to issue up to $3 billion in currency.(Anderson, 2010, page 1.)

In the post-war period, there was also an attempt to use changes in the composition of the Central Bank's balance sheet in order to tilt the yield curve. 'Operation Twist' was a policy adopted by the Federal Reserve Board in February 1961. This represented a change in the policy that had been in place since 1953. The New York Fed as the operating arm of the Federal Open Markets Committee was restricted to purchasing and selling short-term bills as part of its open market operations. The new policy allowed them to buy also long-term government bonds of up to 10 years duration. The intention of this policy was to try to stimulate domestic economic activity and at the same time to help improve the US balance of payments position which had been in deficit for many years. The hope was that the reduction in long-term interest rates as a result of the purchase of bonds would stimulate domestic demand, whilst higher short-term interest rates will attract foreign capital. The New York Fed as the implementor of the policy were required to buy no more than $500mn before the next meeting of the FOMC. In total some $8.8bn of bonds and bills over one year maturity were purchased. This is equivalent, at today's prices and proportional of national income, to almost $225bn. Well short of the $1.7 trillion that was purchased under the recent QE1 policy.[21]

There was also a short period in UK monetary history, when a policy of "over-funding" was used as a way of doing the inverse of QE and constraining monetary growth by issuing government bonds in excess of the needs to finance government expenditure and selling them to the non-bank private sector. Nigel Lawson (1992), then the Chancellor of the Exchequer, admitted that the use of overfunding was a way of massaging the money supply to make it look as if monetary policy was tighter than it actually was. Overfunding averaged £3.4 billion a year over the four years 1981-82 to 1984-85. On average M3 grew by nearly 4% a year less than if there had been no overfunding. By selling more gilts than was necessary to fund the budget deficit the Bank of England bought Treasury bills or commercial bills from the market. This lead to complications in the longer run as the Bank of England accumulated a vast and growing mountain of bills which made in practice the day-to-day conduct of monetary policy increasingly difficult. It slightly tilted the yield curve lowering short of interest rates and raising long-term interest rates. The policy was eventually abandoned at the end of 1985.[22]

[21] For a critical evaluation of Operation Twist see Ross (1966).

[22] Lawson describes this result as an 'own goal', p.459.

2.3 Quantitative Easing

QE has come into the general lexicon of economics, as the zero bound on policy rates began to bite outside of Japan. Figure 2 illustrates the scale of the recent problem for the UK. Broadly speaking policy rates lie close to the rate of growth in nominal GDP, as this comprises real economic growth and inflation, and corresponds to the rate implied by an active interest rate rule. What we can immediately observe from the 2008-9 recession is that Bank Rate just looked too high against this metric and so another tool seemed to be required. Figure 3 reminds us that most major economies are now at levels of policy rates close to those chosen by the Bank of Japan since the beginning of 2009.

The term Quantitative Easing was first coined in Japan to describe the adoption of a 'novel' approach to the conduct of monetary policy when interest rates are close to zero. Following the collapse of asset prices in December 1989 Japan began to experience deflation by early 1995. Forecasters and policymakers consistently underestimated the seriousness of Japan's economic problems. After conventional monetary action proved ineffectual, the Bank of Japan began quantitative easing on March 19, 2001, and continued the policy until March 9, 2006.

Under this policy, the Bank shifted its day–to–day operating target from the overnight, call–money rate to the level of reserves (current account balance) held by banks at the Central Bank. Over the five years the Bank of Japan raised reserves target nine times. The Bank of Japan achieved this by purchasing Japanese government bonds from the banks and 'printing money' to pay for it. The objective was to flood banks with excess reserves in order to encourage them to lend. At the same time the Bank of Japan committed itself to maintain QE until the core CPI (excluding energy and food) either reached zero or rose on a year–over–year basis for several months.[23]

The question is, did it work in Japan? This raises the usual problem of the counterfactual. The core inflation rate did turn positive at the time of the exit from QE and the policy appears to have ; and while the broader measure of inflation remained positive for much of the period until 2009, the core price level continued to decline. Underlying output growth fared better, with an average growth rate of 2.7% for 2006 to 2007, before the onset of the financial crisis, compared with an average of 1.19% from 1990 to 2005. Ugai (2006) in an empirical analysis of QE identified that the channel that works on the expected future path of short-term interest rates was the most important. Baba et al (2006) considered how QE affected the economy in Japan They focus on a neglected effect of QE on the credit risk premiums financial institutions pay. They found that QE lowered risk premiums to extremely low levels, especially in money markets . As a result, not just the levels but also the dispersion of money market interest rates among banks has been reduced to near zero.

Wieland (2009) provides some further empirical evidence for the Japanese experience.

[23] Figure 4 shows the path of Japanese CPI inflation over this period.

During this period the Bank of Japan was able to expand the monetary base and this translated into a greater and more lasting expansion of M1 relative to nominal GDP. As base money grew with QE, so did M1, increasing by more than 30% of nominal income between 2001 and 2005. This expansion of base money encouraged additional deposit creation by banks. This expansion came to a halt in 2006 with the ending of QE. Figure 4 shows though that there was no strong link between excess reserves and bank lending. So despite expansions in excess reserve balances, and the associated increase in base money, during the zero-interest rate policy, lending in the Japanese banking system did not increase and the money multiplier shrank.

Although the financial crisis is regarded as a once in a century experience for many western countries, from the Japanese point of view it is actually the second crisis in 20 years. One difference for Japan and which marks it out from what happened in the 1990s, is that this time the cause lies with an exogenous shock from the rest of the world, rather than - as was then the case in the 1990s - an endogenous banking crisis arising from the banking system's involvement in the commercial property market in Japan. The contraction in world trade that followed the financial crisis hit Japan particularly badly. Although the Japanese financial system had some exposure to complex securitised assets, it was much smaller than in Europe and the US. Japan adopted a number of policies which differ in many ways from what happened elsewhere. In order to protect the operation of the Japanese financial system Japanese regulators moved quickly to carry out stress tests on financial institutions. To ensure the proper functioning of financial markets steps were also taken to discourage short selling of shares. The Bank of Japan also sought to provide liquidity to financial markets. With the onset of the crisis Japan returned in 2008 to various forms of easing, in particular the purchase of asset backed commercial paper and corporate bonds. However, Japan's return to QE was nothing like the scale of 2001 to 2006, nor as large as that taking place in North America and Europe. This has, therefore, put upward pressure on the Yen also experienced by Brazil. Japan did not return to QE until 2010, faced with falling prices and an appreciating Yen. Despite prompting from the Japanese government at the end of 2009, the Bank declined to do so, arguing that the policy would not be effective.

The Federal Reserve Board, along with other Central Banks, responded in the conventional way to the financial crisis in 2007 by lowering short-term interest rates dramatically. The Fed also used open market operations to inject liquidity into the banking system. However, because of a reluctance on the part of banks to be seen borrowing at the discount window, in December 2007 a new method for providing liquidity to the financial system was adopted: the Term Auction Facility (TAF). This facility was part of a coordinated strategy among the major central banks around the world. In response to the continuing financial crisis the Federal Reserve extended the range of its unconventional instruments.

The US Federal Reserve began a policy of quantitative easing in December 2008.

Bernanke (2009) was quick to argue that it should perhaps be described as 'credit easing', to distinguish it from Japanese QE. The Fed finally announced the introduction of quantitative easing in March 2009, a little time after the Bank of England's introduction of quantitative easing. Initially $1.2 trillion was used to purchase government bonds and also mortgage related securities. A further $500 billion was then added. But during the autumn of 2010 there was further discussion about the possibility of launching QE2: an extra tranche of quantitative easing.[24]

The way in which the ECB responded to the financial crisis differs in many ways from how other central banks responded. These differences it is argued reflect the different economic and financial structures in the euro area compared in particular with the US. With the onset of the interbank crisis in the summer of 2007 the ECB immediately increased the availability of liquidity to the banking system. They provided €95 billion within a few hours of the crisis emerging. A year later September 2008, with the virtual paralysis of the interbank lending market, the ECB changed its policy implementation procedure whereby banks had access to virtually unlimited liquidity at maturities of up to 6 months. The ECB also expanded the range of assets that they would accept as collateral. Because of the central role that the banking system performs in the euro area, the focus of the ECB policy has been on the preservation of the banking system.

The ECB did not use qualitative or credit easing by purchasing government bonds in the euro area at first, because it did not believe that this was the appropriate instrument in conducting monetary policy for the Euro Area. The non-conventional measures used focused on the provision of liquidity to the banking system. In 2009, the ECB introduced (with a fixed rate full allotment procedure) three new OMOs, i.e. longer-term refinancing operations with a maturity of 12 months each. Similarly, in June 2009, it launched the covered bond purchase programme (CBPP) for EUR 60 billion with the aim to reactivate trading activity in the covered bank bond market. Last, with the Securities Market Programme (SMP), the ECB also introduced fixed-term deposits, i.e. liquidity absorbing operations, to absorb an amount of liquidity equivalent to the liquidity injected through the SMP. More recently, in May 2010, in response to the sovereign debt crisis, the ECB introduced the Securities Market Programme, whereby the ECB can intervene in particular financial markets to ensure depth and liquidity where those markets have become dysfunctional with the possibility of "disorderly deleveraging" and the associated disruption of the transmission mechanism of monetary policy. These interventions would be in both public and private markets.

The Bank of England launched its programme of quantitative easing in March of 2009.[25] The purchase of nearly £200bn of UK government gilts since then by the Bank

[24]Figure 6 simply shows the stock of bond purchases in the UK and in the US under the first bout of QE and there seems to be little direct impact over time but any relationship is likely to be highly complex.

[25]We leave other measures such as the Securities Lending Scheme to one side.

of England's Asset Purchase Facility (APF) has increased the size of the Bank's balance sheet to some three times its normal size: to levels not seen since the end of WW2 or the aftermath of the Napoleonic wars. These purchases amount to some 14% of GDP or well over 20% of outstanding UK public net debt. The APF has operated with full indemnity from the Treasury, which receives all profits and will bear any losses. Figures 7 and 8 show the impact of these measures and others on the size of the Bank of England's balance sheet.

The APF has three functions: to borrow an amount set by the MPC at Bank rate from the Bank of England; to use that cheap funding to buy government bonds from the non-bank financial sector; and to stand ready, on the instructions of the MPC, to sell those bonds back to the same sector in some more stable state of the world. In response, the rest of the financial system has taken the following steps: the Bank of England has financed its loans to the APF by issuing reserves to the banking sector, the non-bank financial sector (OFC) has gone short £200bn bonds in exchange for bank deposits, commercial banks have ended up with higher deposits and matching reserves and, concurrently, the government has issued some further £135bn of net debt over the same period.

A rough back of the envelope calculations would suggest that if the average coupon on purchased gilts (absent the small quantity of corporate bonds bought) is some 5%, £200bn of bonds pays the Treasury £10bn a year, while the interest paid on the increased reserves at the Bank of England is only 0.5%. It looks like the Treasury is making a tidy profit of more than £9bn, or at least subsidising its own payment of interest by that amount. This of course has to be set against possible capital losses as the APF sells bonds in the future back into the bond markets. But if easing lasts the 5 years that the Bank of Japan maintained QE, then it would require a very large rise in yields on debt to wipe out the profit.

There has been some concern from financial market participants about the way in which the total quantity of purchases was explained and arrived at but given the scale of the crisis, some lack of transparency and ongoing discretion in plans is forgivable. At, or near, the zero lower bound, bonds and cash become very close substitutes and, even in normal times, UK government bonds seem very nearly as liquid as cash. This means that there is very little scope for APF purchases to have much traction on portfolios and wealth holdings and yet each auction of government bonds was very well covered with OFCs more than willing to exchange large fractions of their holdings of government debt for cash.

One answer is that the scale of the purchases and their duration were able to magnify any small degree of imperfect substitutability between bonds and cash, which may in any case become that little more different in times of great stress.[26] An alternative possibility

[26] Clearly in open market operations government paper remains eligible collateral, and so remains an almost perfect substitute for cash. But with longer term purchases, such as under QE, the substitutability

is that buying government bonds allowed the OFC to absorb more easily the increase in government debt without prices having to fall too much. Either way, the APF sells pure liquidity to OFC in exchange for an annual return of some 4.5% on its operations. OFCs, flush with this liquidity, then can both have their temporary pick of other assets, including newly issued government bonds, reasonably safe in the knowledge that it will eventually be able to buy back its debt when interest rates have gone up and the price of that debt will almost certainly be lower.

Thus the liquidity now held by OFCs ought to move along the maturity and liquidity spectrum of assets and bump up prices across the board, which when we examine interbank lending rates, corporate debt and and some equity prices seems to have happened. But the evidence is far from completely convincing. But if we accept that bonds and cash are not perfect substitutes in a deep recession, QE simply exploits the fact that in a financial and economic log-jam, private institutions are particularly interested in having access to liquidity, so much so they are willing to give up several times Bank rate for the privilege.

2.4 Modelling the Effectiveness of QE

The New Keynesian framework used to underscore so much of monetary policy analysis in the past decade has considerable difficulty with incorporating open market operations, such as QE, and assigning them a role. In a classic statement, Eggertsson and Woodford (2003) show that the existence of a rational expectations equilibrium is independent of the quantity of base money, the composition of the central bank balance sheet and the composition of the government's non-monetary liabilities. This is because any change in these "do not change the state-contingent consumption of the representative household, (which) depends on equilibrium output". In order therefore for open market operations to matter directly we need to establish some link between portfolios and equilibrium output, which we will consider shortly.

The alternative, and that is the heart of the New Keynesian case, is simply to argue that all types of monetary policy announcements, such as QE, are simply devices supporting the commitment of the monetary authorities to hit any given inflation target. (Or preferably, the price level trend implied by the inflation target over the long run.) By ensuring that monetary policy commits to a course of action that will keep the economy growing at its flex-price optimal rate, forward looking agents will expect the price level to conform to that consistent with the attainment of the inflation target. And so, if credible, even in the midst of a deflation or disinflation, agents will still expect a positive rate of inflation in order to hit the long-run price level target, which will imply a negative real rate at near zero nominal rates. This kind of channel implies a very important role for forward-looking expectations and implies a commitment to a level of central bank money

may not be perfect.

expansion that would occur if rates could move sufficiently negative.

The problem with a purely signalling effect of QE is that if it does not have any effects within the maintained model, and it is difficult to understand why using it would matter for the determination of quantities and prices. That is not to argue that signalling does not matter, as there is a substantial literature on the importance of communication and explanation of the likely path of monetary policy to which new tools of monetary policy might usefully contribute (see Gurnayak et al, 2005). But if, in the model employed, a particularly tool has no role how can its signal then also matter?

Let us now turn to an alternative possible channel. The fiscal channel suggests that monetary injections may relax the government's budget constraint and allow an excess of expenditure over receipts without necessarily leading to an increase in the private sector's holdings of government debt. Auerbach and Obstfeld (2005) construct a model in which a permanent, or credible, monetary injection can immediately alter the price level because the trade of money for interest rate bearing government liabilities reduces debt service costs. The impact is considerably attenuated in the case of a temporary monetary injection and the welfare benefits depend on the extent to which future distortionary (labour) taxation is replaced by an inflation tax. The authors interpret the increase in excess reserves in the Japan, following the start of QE in 2001, in terms of their model as implying that the monetary base expansion was not treated as permanent and/or that the return to positive interest rates is treated as quite distant and so any increase in broad money is delayed.

The monetary, or portfolio, channel, rather than a simple force driving inflation, is based on the idea that money and other assets are imperfect substitutes. And so an increase in the money supply will induce the private sector to rebalance its portfolio and so raise prices and lower expected returns of non-monetary assets. But if money is treated as an asset, yielding safe returns equal to the negative of the inflation rate, it is possible that money may just be held and so have a limited portfolio re-balancing. Clearly the central bank might have more impact under these circumstances from purchasing assets that are more rather than less illiquid.

Earlier work, Bernanke et al (2004), examining the Japanese experience with QE found little by way of announcements effects. Though there did seem to be significant yield curve consequences from purchases of US Treasuries by overseas institutions with $1bn of purchases leading to around 0.6-0.7bp off medium term yields and from a macro-finance yield curve some evidence to suggest that Japanese yields were some 50bp lower than expected during QE. Recently released empirical estimates of the impact of the initial £125bn of QE and then the full £200bn (14% of GDP) on UK gilt yields by Meier (2009) and then Joyce *et al* (2010) suggests that yields are some 40-100bp lower than they would otherwise have been in the absence of QE.[27] For the US, Gagnon *et al* (2010) find that the $300bn of US bond purchases, which amount to some 2% of GDP, resulted

[27] The chapter by Caglar et al briefly surveys these results.

in falls of some 90bp in US 10-year Treasuries. These results do not quite seem to fit the results of Krisnamurthy and Vissing-Jorgensen (2010) who find that a reduction in public debt outstanding of around 20% of GDP in the US, will reduce yields by between 61 to 115 bp. The former estimates are mostly based on an events study approach of announcements rather than actual purchases and emphasize the importance of the portfolio re-balancing channel rather than the *pure signalling* effect. Although plausible, the results do not seem especially uniform across the announcement dates and we await more detailed results from estimation of the supply and demand curves for government liabilities, which are complicated by the continuing and large scale issuance of government debt over this period.

3 Contribution of Papers

Money itself does not enter the objective function of central banks and sits somewhere as part of the information set on which interest rate paths are predicated. To that extent the analyses of Douglas Gale in this volume is particularly welcome, as it focuses on what economic theory can tell us about the regulation of liquidity in a financial system. The efficient provision of liquidity is analysed in an 'Arrow-Debreu' general equilibrium model of the financial system. This benchmark model allows the causes of market failure to be identified and the circumstances in which to improve welfare central bank interventions might be necessary. In particular the incompleteness of markets can lead to inefficient liquidity provision and, in some cases, to market crises. In certain circumstances, market failures are relatively benign and can be rectified by requiring banks to hold adequate amounts of liquid assets - which pay the risk free rate of return - and implies that financial intermediaries hold either or both of reserves and T-bills. In other cases, more extensive interventions by the central bank are required as "lender of *first* resort to replace frozen markets".

Gale suggests that these central bank interventions may also require an expansion of wholesale funding; and asks whether this will be possible without risking instability. The answer depends on the successful implementation of effective liquidity regulation. Apart from the desire to increase the capacity for lending in the global financial system, a revival of the Parallel Banking System may offer an opportunity to improve the transparency, stability and efficiency of the financial system by creating a new and well regulated type of limited purpose financial company, what he calls a Narrow Bank, to replace the miscellany of vehicles that blossomed in the boom years before the crisis of 2007-2008. The key insight from Gale is that we need to understand the reasons why liquidity dried up in order to avoid a repeat of the sub-prime crisis, and to design a more stable and efficient financial system for the future.

In their chapter, Jan Wenzelburger and Hans Gerbach investigate analytically a banking system embedded in an overlapping generations model, which is subject to

repeated macroeconomic productivity shocks. They show how a series of negative shocks may cause a systemic default of the banking system. By lowering interest rates, the central bank can increase intermediation margins, which promotes bank recapitalisation. They go on to present a positive analysis of how interest-rate policies may resolve a banking crisis and also provide reasons why banking crises may cause long-lasting economic downturns. They suggest that when interest-rate policies are aimed only at avoiding a systemic default, the economy may converge to a consumption trap. In the consumption trap, entire bank savings are needed to cover the banks' obligations and GDP growth is minimal. The key policy conclusion in this model is that central banks must act to ensure that banks are adequately capitalised and this can be, of course, brought about by a number of policy initiatives running from large scale liquidity provision to the purchase of badly performing assets through to nationalisation of banks. The need to maintain adequate bank capital to prevent a consumption trap may imply a link between financial and macroeconomic stability, which had been previously neglected.[28]

John Driffill and Marcus Miller try to understand recent developments with reference to a macroeconomic model, which includes the effects of quantitative easing in particular. They first sketch how the model of Kiyotaki and Moore (2008) can be used to illustrate the threat posed by the liquidity crunch. Then they report the results of a numerical exercise by the New York Fed, which uses this framework to calibrate the effect of QE in avoiding severe economic contraction in the US. The first question posed is why should entrepreneurs hold money if other assets – equity in particular – offer higher yields? The answer is simply that these other assets may become illiquid: if limits to equity sales and new equity finance become binding, for example, shares will not provide the purchasing power needed by entrepreneurs who come up with new ideas for investment. Knowing that future investment initiatives may be thwarted in this way generates a precautionary demand for money by forward-looking entrepreneurs. The rate of capital formation is simply determined by Tobin's Q, where entrepreneurs will have an incentive to go ahead if the market value of investing exceeds the cost of the resources required, i.e., so long as Tobin's q is greater than one, where Tobin's q represents 'the shadow price in terms of consumption goods of a unit of installed capital'. The margin required between market value and replacement cost is usually explained by the need to cover increased costs of installation: however, the margin may also be due to the presence of credit constraints that bind more heavily as investment increases. These credit constraints on the calibration presented imply a depression of some 10% from baseline, which can be ameliorated to a deep recession of some 6-7% below baseline. In the model this increase in liquidity is achieved by a swap of illiquid equity for liquid money. Naturally, the effectiveness of the policy depends on the liquidity premium on cash and the quantity of the swaps undertaken but, in general, it is only a depression rather than recession that can be

[28] In other words, what has become known as the Separation Principle, whereby monetary stability and financial stability are pursued separately, may not hold, see Clerc and Bordes, 2010.

avoided

In his chapter, Richard Harrison considers a simple modification of the NK framework by allowing imperfectly substitutable assets. The model posits a financial intermediary that borrows from the government at both long and short maturities and makes one-period loans to households. Portfolio adjustment costs are introduced into the profit functions of financial intermediaries so that the larger their holdings of short-term bonds, the more they value long-term bonds. This assumption is motivated by the notion that agents are more willing to hold less liquid assets if they have ample holdings of liquid assets. The result is that the rate of return faced by households is a weighted average of the market yields on long-term and short-term debt. The market yield on long-term bonds in turn depends on the portfolio mix held by financial intermediaries. This setup creates a wedge between the market rates of return on long and short bonds. This approach is a simple and elegant way to capture the notion that relative asset prices depend on their relative supply and provides a channel through which asset purchases by the policymaker can affect aggregate demand. Because assets are imperfect substitutes, the policymaker can use asset purchases to alter the relative supplies of assets and hence bond returns.

To the extent that central bank asset purchases reduce long-term interest rates (over and above the effect of expected future short rates), aggregate demand can be stimulated, leading to higher inflation through a conventional New Keynesian Phillips curve. But this channel also implies that the operation of traditional monetary policy is constrained because long-term interest rates depend not only on the current and likely stance of policy rates but also on the relative liquidity of financial intermediaries. In principle, a given change in policy rates will have less of an impact on long-term rates because it will induce a change in debt financing costs and cause the financial intermediary to switch its portfolio of short and long-term assets in the opposite direction to the change in short-term rates. In the version of the model with perfect substitutability, a 100bp cut in policy rates will lead to a 8bp fall in the five year spot but with imperfect substitutability, long-term rates will only fall by around 4-6bp. For this calibration it is implied that liquidity effects reduce the effectiveness of monetary policy in stabilising the economy.

Stefania Villa and Jing Jang estimate - using Bayesian estimation techniques - a recently developed model of Gertler and Karadi (2009) that combines financial intermediation and unconventional 'monetary policy', using UK data . To validate the fit of the estimated DSGE model, they provide an evaluation of the model's empirical properties. Then, they analyse the transmission mechanism of the shocks during a downturn; and finally they estimate the empirical importance of nominal, real and financial frictions and of different shocks. Their main findings are that the data strongly favour a model with financial frictions for the UK economy; the sharp rise in spreads since the recent crisis can be mainly attributed to credit supply shocks; and so some form of credit policy - over and above Bank rate - might help to make the simulated contraction less severe.

Domenico Giannone, Marco Lenza, Huw Pill and Lucrezia Reichlin come to the same conclusion from an almost diametrically opposed position. They show that the behaviour of key financial and monetary aggregates – notably bank loans to non-financial corporations and (albeit to a somewhat lesser extent) households – can be explained on the basis of historical regularities estimated in the pre-crisis sample, once developments are conditioned on the actual path of economic activity. In other words, one does not need to rely on exceptional or aberrant behaviour in the financial sector to explain developments in money and credit following the failure of Lehmans. The ensuing weakness of economic activity is sufficient to account for what was observed. These results can be interpreted as evidence that the non-standard measures introduced by the ECB following Lehman's demise were successful in insulating bank credit provision to households and firms from the breakdown of financial intermediation seen in the interbank money market. By implication, propagation via financial collapse – seen as central to the emergence of the Great Depression in the 1930s – was largely avoided. In this sense, the non-standard monetary policy measures introduced by the ECB in the autumn of 2008 can be seen as successful. This does not imply that there were not macroeconomic consequences but that any extra amplification via the financial collapse may have been avoided, at least in the first round.

Sharon Kozicki, Eric Santor and Lena Suchanek in their contribution consider the impact of quantitative easing on long-term interest rates. The paper examines the effect of central bank balance sheets on long-term forward rates for a sample of developed countries. The empirical results show that - controlling for expected inflation, projected fiscal indebtedness, and other macro variables - an increase in central bank assets is associated with a decline in long-term interest rates. The approximate impact found from an increase in the ratio of central bank holdings of government debt to GDP, or the ratio of central bank assets to GDP, suggests a wide range of responses in 10 year government bond yields from around -0.3 to -0.07 percentage points, which in the UK would imply a fall in yields of no less than around 100bp.

Spencer Dale outlines the lessons from quantitative easing on the anniversary of the first operations in March 2009. He addressed three key questions: What is the theoretical foundation for such a policy? What are the key channels of transmission? And what can we say about its impact to date? These questions are naturally critical for both the operation and study of monetary policy. He echoes the observation that the financial crisis posed questions which models most commonly used to analyse monetary policy were not well suited to answer. Although there is an emerging literature that responds to these shortcomings. It is important – both for the theory and practice of monetary policy – that this continues. His own estimate of the impact of QE was that the £200bn of purchases of bonds from non-bank financial intermediaries had reduced medium term bond yields by 100bp.

Mike Wickens challenges the perception that the financial crisis was due to flawed

macroeconomic and finance theory. Much of this is media criticism he argues, but written by academics. He insists that the fault lies more in the failure of banks, and other financial market participants, to use existing theory correctly, especially the theory of risk. Although most modern macroeconomic models do not include a banking sector and much of finance theory takes little or no account of the macroeconomic environment, a consequence is that the financial crisis has stimulated a huge amount of research on how best to model the banking sector in dynamic stochastic general equilibrium (DSGE) models. Compared with the previous generation of DSGE models this might be thought of as unconventional macroeconomic modelling. Unfortunately, much of this research is misplaced as it involves introducing arbitrary exogenous restrictions and ignores the key issue of default.

For example, as already noted, Harrison (2010) assumes that households have an exogenous target ratio of long to short-term debt. In a widely cited paper, Kiyotaki and Moore (2008) assume that firms invest with an exogenous probability, that only a fraction of new investments can be funded initially, and only a fraction of a firm's financial capital can be used initially to offset this funding restriction. All of this creates a liquidity constraint. Negative shocks to these frictions, such as those that started the financial crisis, make the constraint more binding and the likelihood of a recession more probable. Not surprisingly, once these constraints are alleviated by, for example, a liquidity infusion by the central bank, the crisis and the recession can be checked.

Wickens feels that such explanations do not address the real cause of the crisis, namely, default risk. This was largely ignored by the banks when providing new mortgages, by the credit rating companies when evaluating mortgage backed securities, and by the financial sector when buying these securities. Default risk also lies behind the liquidity crisis as it deterred interbank lending. What is required is the inclusion of a banking sector in these models in which default risk drives a wedge between lending and borrowing rates. The probability of default should be modelled as endogenous rather than exogenous as it depends on the business cycle, being higher in periods of recession than boom.

The final paper by Evren Caglar, Jagjit Chadha, Jack Meaning, James Warren and Alex Waters assesses the conjunctural impact of QE in the UK and provides some preliminary results on the impact of non-standard policies in DSGE models, which take seriously the role of financial frictions. They find that it is possible to generate the correct qualitative effects of a lower zero bound in the DSGE models by (i) offsetting the liquidity premium embedded in long-term bonds and/or (ii) providing a countercyclical subsidy to bank capital and/or (iii) creating central bank reserves that ameliorate the costs of loans supply. But the correct quantitative response and the appropriate interaction with standard monetary policy, particularly with respect to the exit strategy, remains an open question.

4 Concluding Remarks

In launching this conference and this new Cambridge series on Modern Macroeconomic Policy Making, we hope to improve the dialogue between academics, city-based economists and policymakers. The challenges ahead require not only more work but, to coin a current phrase, a 'coalition' across various methodologies and approaches. One lesson from the financial crisis is that a high degree of belief in one model across many agents, does not necessarily lead to aggregate stability. But as well as pooling resources, economists are learning about genuine gaps in their understanding of the causes of aggregate fluctuations. And rather than abandoning progress along a difficult road in matching micro-foundations to macroeconomic theories of fluctuations, the discipline is developing a class of models in which collateral or liquidity constraints and financial intermediaries play a substantive role in determining macroeconomic outcomes and, as a significant by-product, helping us understand the monetary transmission mechanism.[29]

Much of the focus of the new work has been to develop unconventional monetary policies, such as QE. The question is then also whether we ought to treat QE as an extreme measure or something that might in time, become part of the central bank's regular toolkit. For example, could we use negative QE - or over-funding as we have referred to it earlier - as well as raising interest rates if house prices, debt and money were to expand at a worrying rate? Perhaps also the absence of significant purchases of assets other than gilts ought to make us ask why there is so little corporate debt in the UK financial system compared to the US. Also we wonder what we learn about the limits to the private sector supply of liquidity in that it was unwilling to enter in exactly the same trade using cheap money. With the emphasis on the quantity of liquidity as well as its price, central banks seem to be telling us something about the limits of standard interest rate rules and imply a truth from an old economic maxim: that when prices, in this case of money, cannot adjust quantities must.

As well as reading the runes in emergent theory, policymakers had to deal with the crisis as it unfolded and quickly accepted that the limits to our understanding could not prevent some sort of response being fleshed out. Immediate questions such as whether to bail out individual banks were quickly overtaken by issues of systematic liquidity shortages, as the interbank market froze. Liquidity issues developed into ones of credit risk and it became clear that the unwinding of compressed spreads in financial markets compounded the vulnerability of households and firms with considerable debt on their balance sheets. These debts were the counterparty of high and escalating levels of gearing by financial intermediaries. Whatever the instruments used to stabilise the economy, at or near the zero bound, the levels of outstanding gross claims across financial institutions and private agents, as well as latterly, across governments seems likely to play a role in

[29] See Caballero (2010) for a more pessimistic view on the ability of mainstream (core) models to successfuly adapt in the face of the financial crisis.

determining the level of economic activity for some time to come.

Much of the previous generation of macroeconomists were concerned with the trade-off between output and inflation and found that attaining monetary policy credibility was the route to establishing the best, or optimal, trade-off. It would be ironic if the new obligations to ensure both financial and monetary stability that are likely to be handed to central bankers provides another set of trade-offs which threaten hard won monetary credibility. If two objectives are to be pursued that at least two instruments are likely to have to remain in play. We shall see.

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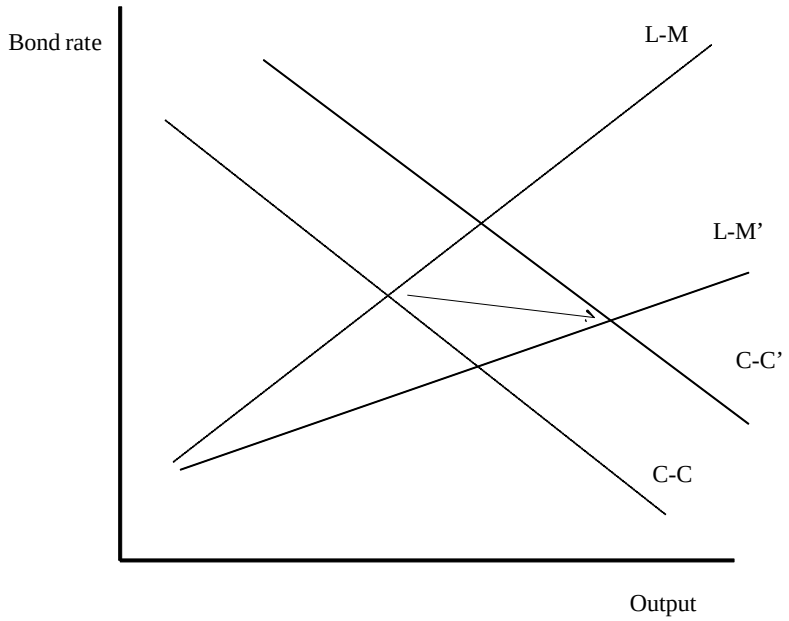

Figure 1: QE in a C-C/L-M framework

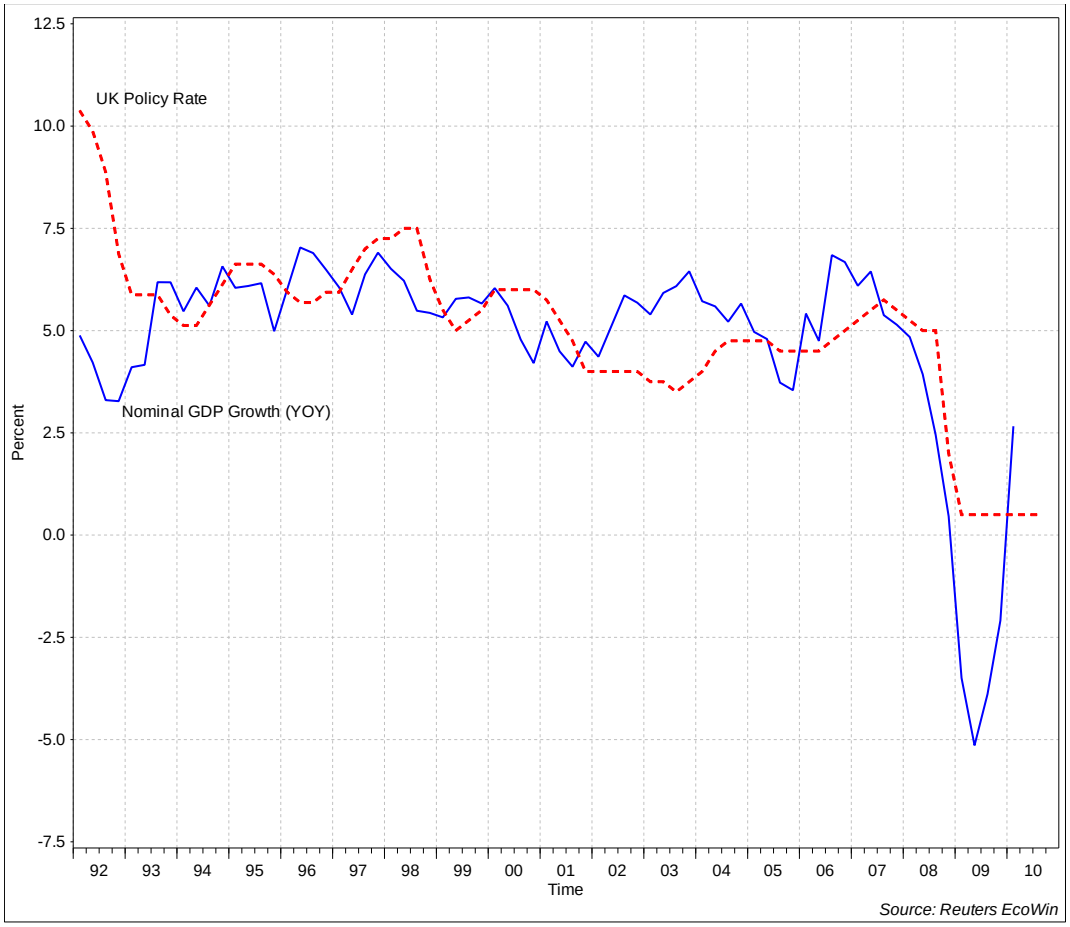

Figure 2: UK policy rate and nominal GDP growth

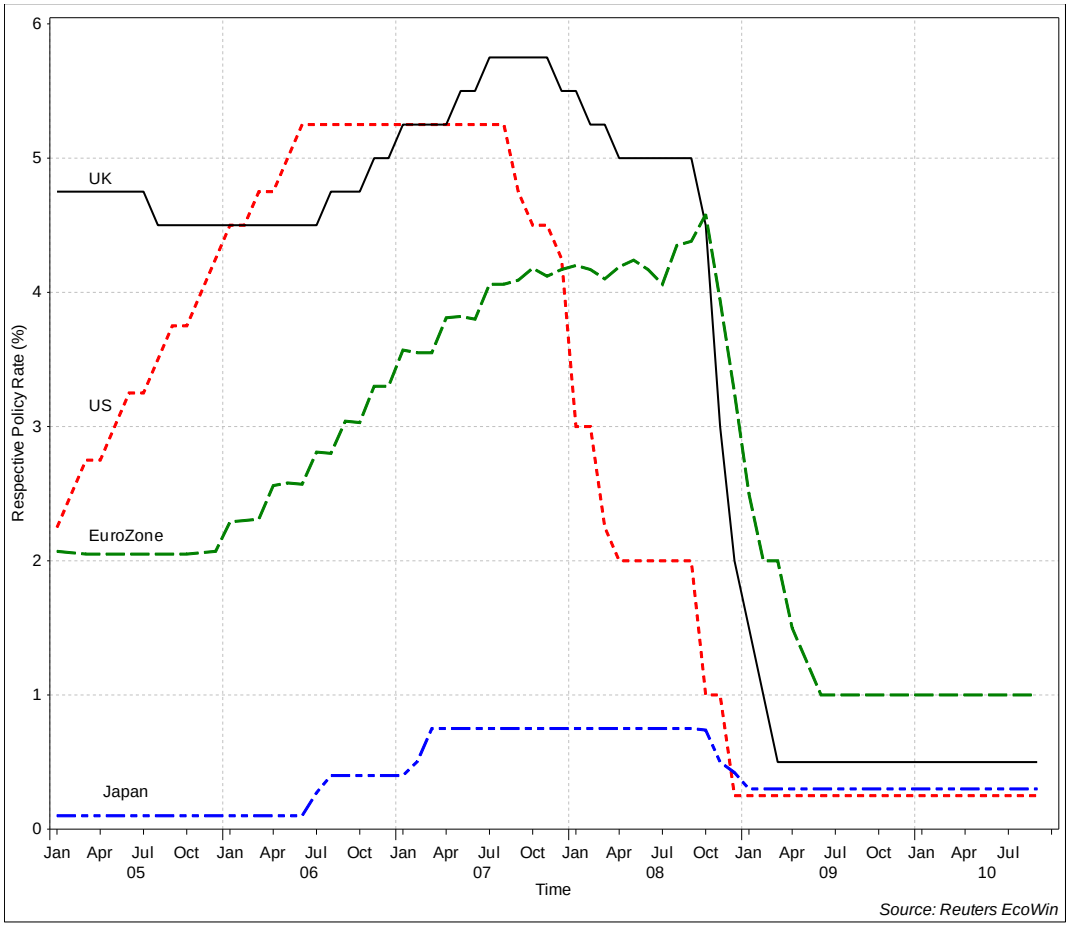

Figure 3: Policy rates

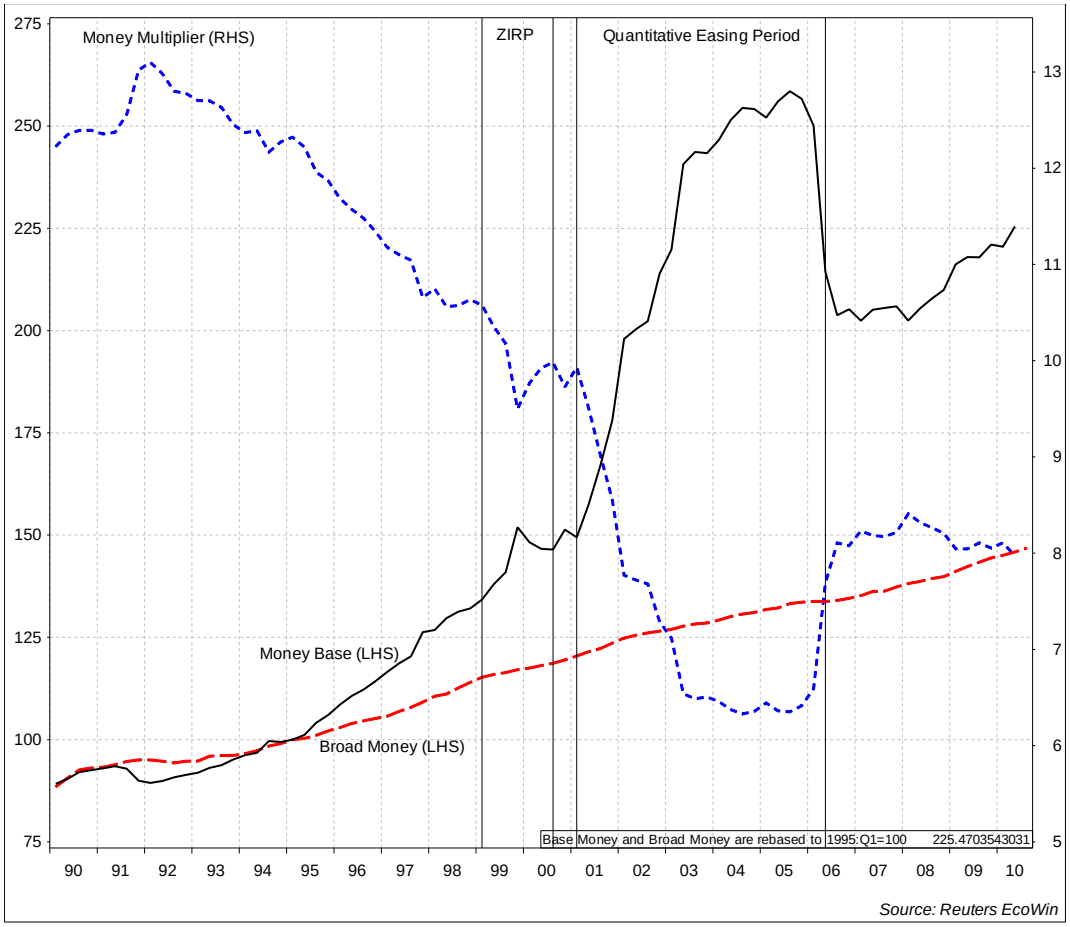

Figure 4: Money multiplier

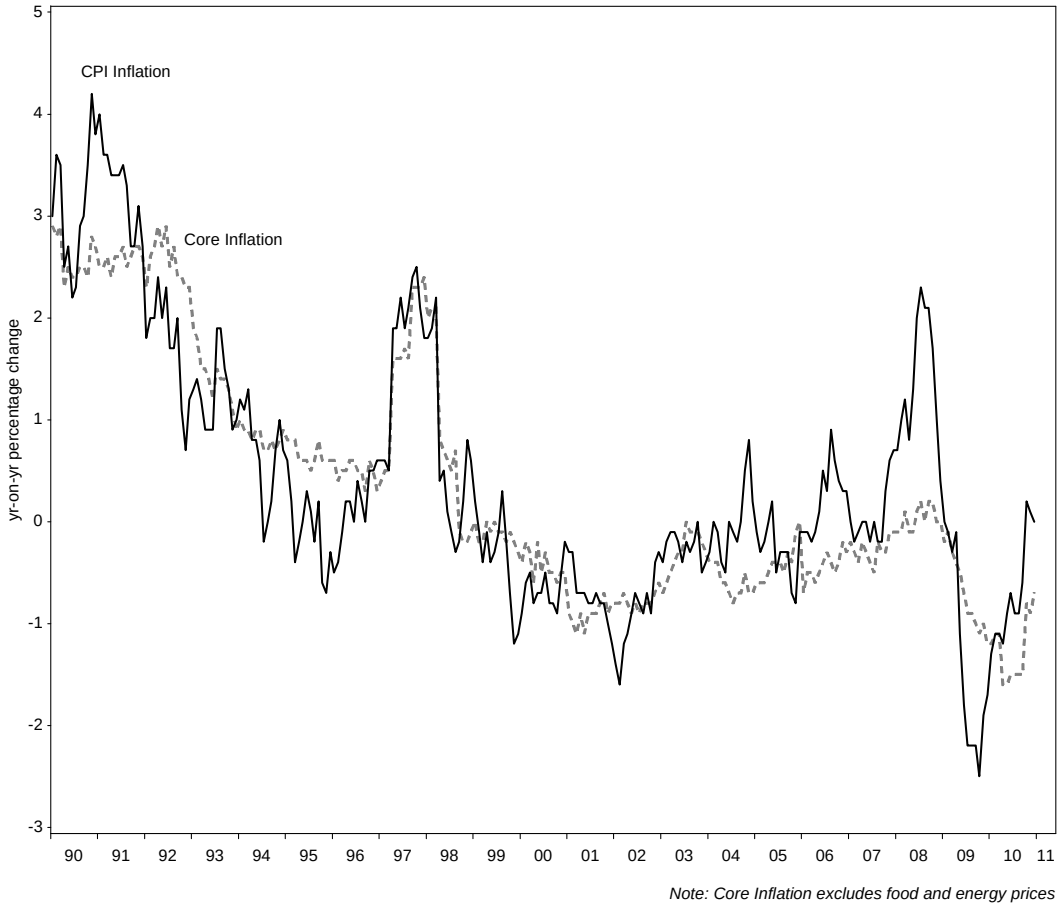

Figure 5: CPI and core inflation in Japan

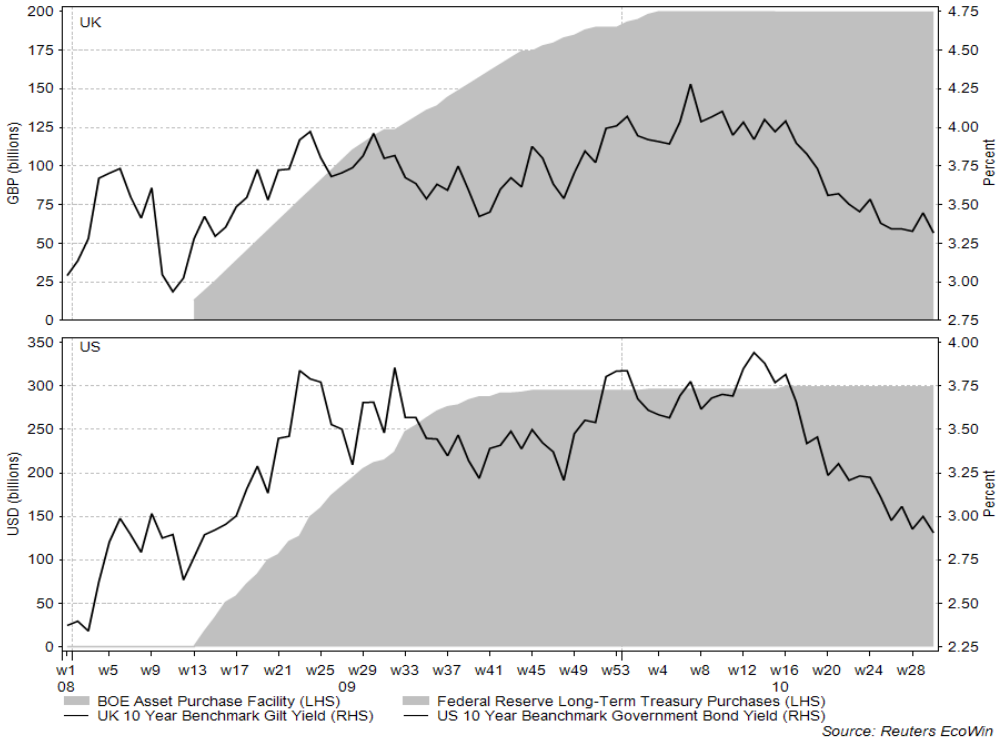

Figure 6: Bank of England and Federal Reserve purchases of assets

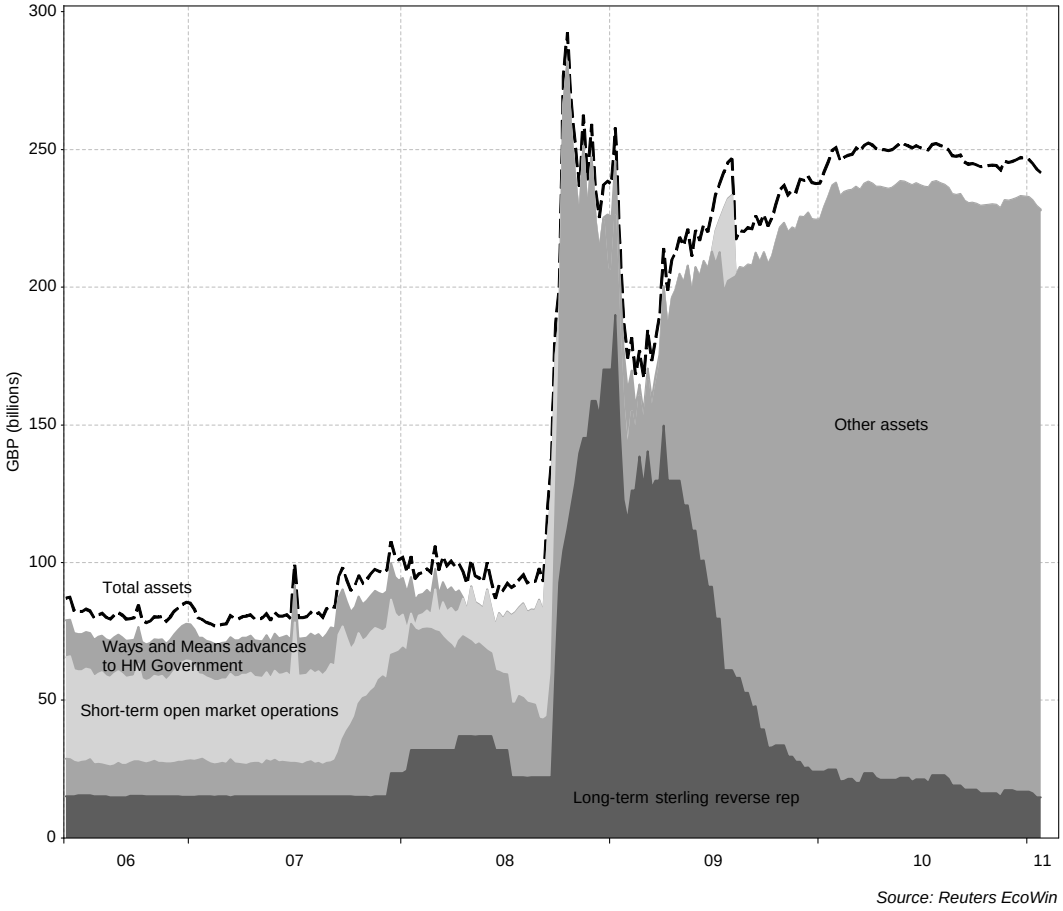

Figure 7: Bank of England's balance sheet - Assets

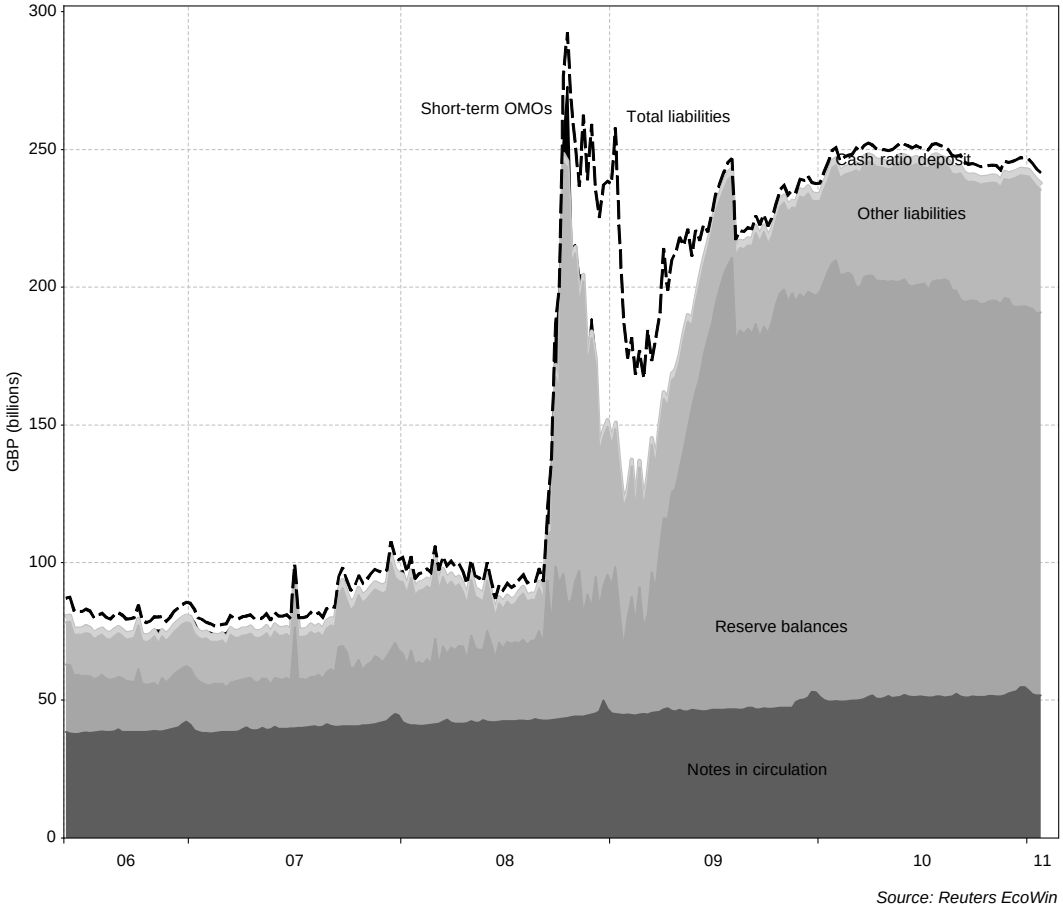

Figure 8: Bank of England's balance sheet - Liabilities