

# **CENTRAL BANKING AFTER THE CRISIS**

by

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November 2012

Prepared for the 16<sup>th</sup> Annual Conference of the Central Bank of Chile, Santiago, Chile, November 15 and 16, 2012. The views expressed here are my own and are not necessarily those of Columbia University, the National Bureau of Economic Research or the Central Bank of Chile. Disclosure of my outside compensated activities can be found on my website at <http://www0.gsb.columbia.edu/faculty/fmishkin/>

By the mid-2000s, both academics and central banks had come to a remarkable consensus on what central bank's basic strategy should be. However, with the collapse of Lehman Brothers in September 2008, the world of central banking changed forever. The world-wide financial crisis revealed that some of the basic assumptions underlying the central bank consensus were no longer tenable, requiring a major rethinking on what the role of the central bank should be.

This paper explores where central banking is heading after the recent financial crisis. First it will discuss the central bank consensus before the crisis and then will outline the key facts learned from the crisis that require changes in the way central banks conduct their business. Finally, it will discuss five main areas in which central banks are altering their policy frameworks: 1) the interaction between monetary and financial stability policies, 2) nonconventional monetary policy, 3) risk management and 4) fiscal dominance and monetary policy. The paper then ends with some concluding remarks.

## **I. CENTRAL BANKING BEFORE THE CRISIS**

By the early 2000s, academic research and the experience at central banks led to almost universal support for a monetary policy strategy which has become known as “flexible inflation targeting”.<sup>1</sup> This strategy involves a strong, credible commitment by the central bank to

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<sup>1</sup>The phrase “inflation targeting” to describe this monetary policy strategy creates some confusion because central banks have had very different approaches to the communication strategy surrounding it. Some central banks have announced an explicit numerical inflation objective and treat it as a target – these are classified as fully fledged inflation targeters – while

stabilizing inflation in the long run, often with an announcement of an explicit numerical objective, but which also allows for the central bank to pursue policies to stabilize output around its natural level in the short run. The flexible inflation targeting strategy was deemed to be very successful, with central banks in both advanced and emerging market countries that had adopted it experiencing both low and stable inflation, as well as very moderate output fluctuations. Indeed, from the early 1980s until 2007, the period was dubbed the “Great Moderation”.

Central bankers in advanced economies had also come to accept Milton Friedman’s (1968) famous adage that “Inflation is always and everywhere a monetary phenomenon.”<sup>2</sup> Although they were aware that profligate fiscal policy could make it difficult for monetary policy to keep inflation under control, they took for granted that the fiscal authorities would not be irresponsible in the long run and so the monetary authorities could control their own destiny and keep inflation under control if they pursued appropriate policies.

Most central bankers also took the view that there was a natural dichotomy between monetary policy and financial stability policy so that these policies could be conducted independently. Central bankers were clearly aware that financial disruptions could damage the economy and this is why many central banks published *Financial Stability Reports* to discuss potential threats to the financial system. However, the general equilibrium modeling frameworks

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others are reluctant to be so explicit. For example, the Fed only adopted an explicit numerical inflation objective in January of 2012 even though before this it was in essence following a flexible inflation targeting strategy. The academic and central bank research supporting the flexible inflation targeting framework is discussed in Mishkin (2009a).

<sup>2</sup>This general agreement with Friedman’s adage did not mean that central bankers subscribed to the view that money growth was the most informative piece of information about inflation, but rather that the ultimate source of inflation was overly expansionary monetary policy.

used at central banks did not incorporate financial frictions as a major source of business cycle fluctuations, leading to a view that monetary policy would focus solely on minimizing inflation and output gaps, while it would be the job of prudential regulation and supervision to promote financial stability.<sup>3</sup>

In August 2007, financial markets suffered a major disruption when declines in the value of mortgage-backed securities led to a surge in credit spreads in interbank markets, with the financial system going over the cliff with the bankruptcy of Lehman Brothers in September of 2008 (as discussed in Mishkin, 2011a). The ensuing world-wide financial crisis revealed facts that undermined some of the assumptions underlying the consensus views described above.

## **II. KEY FACTS LEARNED FROM THE CRISIS**

My reading of the crisis suggests that there are six key facts learned from the crisis that have an important bearing on how central banking should be conducted in the future.

### *1. Financial disruptions make the macroeconomy highly nonlinear.*

Financial disruptions are a disruption to the flow of information in financial markets that prevents them from doing their job of allocating capital to productive investment opportunities.

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<sup>3</sup>Although most central bankers supported the dichotomy between monetary policy and financial stability policy, there were pockets of dissent from this view, particularly at the Bank for International Settlements and the Reserve Bank of Australia who advocated that monetary policy should have some focus on financial stability considerations and should be directed at limiting bubbles in asset and credit markets. This will be discussed further below.

Financial disruptions are inherently nonlinear because they involve an adverse feedback loop in which the decline in asset values leads to a contraction in economic activity, which then leads to a further decline in asset values, a further contraction of economic activity, and so on.

As discussed in Mishkin (1991), the adverse feedback loop mechanism involves the decline in asset prices lowering the value of collateral which serves to mitigate adverse selection and moral hazard problems. If a borrower defaults on a loan backed by collateral, the effects of the adverse selection problem are less severe because the lender can take title to the collateral and thus make up for the loss. In addition, the threat of losing the collateral gives the borrower more of an incentive not to take unmanageable risks that might ultimately lead to a default, and it thus reduces the moral hazard problem. These mechanisms work only as long as the collateral is of sufficient quality. During a financial disruption the decline in asset values causes the value of collateral to fall, so that the problems of adverse selection and moral hazard worsen, which causes economic activity to contract. The contraction of economic activity leads to a further drop in asset values, reducing the value of collateral, causing economic activity to contract further, leading to a further decline in asset values, etc.

The events following the Lehman Brothers bankruptcy showed how nonlinear both the financial system and the macroeconomy could be. Indeed in Mishkin (2011a) I have described the phenomena as going over the cliff. The financial system seized up and both credit spreads (such as the Baa-Treasury or junk bond Treasury spreads) and liquidity spreads (such as the TED or the LIBOR-OIS spreads) shot up dramatically. The contraction of economic activity was then highly nonlinear, with real GDP in the United States declining at an annual rate of -1.3% in the fourth quarter of 2008, -5.4% in the first quarter of 2009 and -6.4% in the second quarter of 2009 – but

also in the rest of the world, with real GDP falling by -6.4% in the fourth quarter of 2008 and by -7.3% in the first quarter of 2009.

*2. Disruptions to the financial sector have a very negative impact on economic activity for a long period of time.*

When economies experience deep recessions, typically they subsequently experience very strong recoveries, often referred to as V-shaped recoveries. However, as Reinhart and Reinhart (2010) document, this V-shaped pattern is not characteristic of recessions that follow financial crises because the deleveraging process takes a long time, resulting in strong headwinds for the economy. When analysing 15 severe post-World War II financial crises, as well as the Great Depression, the 1973 oil shock period and the recent crisis, they find that real GDP growth rates were significantly lower during the decade following each of these episodes, with the median decline in GDP growth being about 1%. Furthermore, unemployment rates stay persistently higher for a decade after crisis episodes, with the median unemployment rate 5 percentage points higher in advanced economies. Although we have many years to go until a decade has passed following the most recent crisis, it actually looks like it might have worse outcomes than the average crisis episode studied by Reinhart and Reinhart. They find that 82% of the observations of per capita GDP during the period 2008 to 2010 remain below or equal to the 2007 level, while the comparable number for the fifteen earlier crisis episodes is 60%. We now recognise that the cumulative output losses from financial crises are massive, and the recent crisis is clearly no exception.

### *3. Price and output stability do not ensure financial stability.*

Before the recent financial crisis, the common view, both in academia and in central banks, was that achieving price and output stability would promote financial stability. This was supported by research (Bernanke, Gertler and Gilchrist (1999) and Bernanke and Gertler (2001)) indicating that monetary policy which optimally stabilises inflation and output is likely to stabilise asset prices, making asset price bubbles less likely. Indeed, central banks' success in stabilising inflation and the decreased volatility of business cycle fluctuations, which became known as the Great Moderation, made policy-makers complacent about the risks from financial disruptions.

The benign economic environment leading up to 2007, however, surely did not protect the economy from financial instability. Indeed, it may have promoted it. The low volatility of both inflation and output fluctuations may have lulled market participants into thinking there was less risk in the economic system than was really the case. Credit risk premiums fell to very low levels and underwriting standards for loans dropped considerably. Some recent theoretical research even suggests that benign economic environments may promote excessive risk-taking and may actually make the financial system more fragile (Gambacorta (2009)). Although price and output stability are surely beneficial, the recent crisis indicates that a policy focused solely on these objectives may not be enough to produce good economic outcomes.

### *4. Low interest rates can encourage excessive risk-taking.*

The fact that the low interest rate policies of the Federal Reserve from 2002 to 2005 were followed by excessive risk-taking suggests to many that overly easy monetary policy might

promote financial instability. Using aggregate data, Taylor (2007) has argued that excessively low policy rates led to the housing bubble, while Bernanke (2010), Bean, Paustian, Penalver and Taylor (2010), Turner (2010) and Posen (2009) have argued otherwise. Although it is far from clear that the Federal Reserve is to blame for the housing bubble, the explosion of microeconomic research, both theoretical and empirical, provides support for monetary policy playing a role in creating credit bubbles. Borio and Zhu (2008) have called this mechanism the “risk-taking channel of monetary policy”.

The literature provides two basic reasons why low interest rates might promote excessive risk-taking. First, as Rajan (2005, 2006) points out, low interest rates can increase the incentives for asset managers in financial institutions to search for yield and hence increase risk-taking. These incentives could come from contractual arrangements that compensate asset managers for returns above a minimum level, often zero, and with low nominal interest rates only high-risk investments will lead to high compensation. They could also come from fixed-rate commitments, such as those provided by insurance companies, forcing the firm to seek out higher-yielding, riskier investments. Or they could arise from behavioural tendencies such as money illusion, as a result of which the managers believe that low nominal rates indicate that real returns are low, encouraging them to purchase riskier assets to obtain a higher target return.

A second mechanism through which low interest rates could promote risk-taking is through income and valuation effects. Low interest rates increase net interest margins and increase the value of financial firms, expanding their capacity to increase their leverage and take on risk (Adrian and Shin (2009, 2010) and Adrian, Moench and Shin (2010)). In addition, low interest rates can boost collateral values, again enabling increased lending. This mechanism is

closely related to the financial accelerator of Bernanke and Gertler (1999) and Bernanke, Gertler and Gilchrist (1999), except in that it derives from financial frictions for lenders rather than borrowers.

Micro-empirical analysis provides a fair amount of support for the theory of the risk-taking channel of monetary policy. Jimenez, Ongena, Peydro and Saurina (2009), using Spanish credit registry data, find that low nominal interest rates, despite decreasing the probability of defaults in the short term, lead to riskier lending and more defaults in the medium term.

Ioannidou, Ongena and Peydro (2009) examine a quasi-controlled experiment in Bolivia and find that lower US federal funds rates increase lending to low-quality borrowers, which leads to a higher rate of defaults and yet at lower interest rate spreads. Delis and Kouretas (2010), using data from euro area banks, finds a negative relationship between the level of interest rates and the riskiness of bank lending.

Adrian and Shin (2010) discuss and provide evidence relating to the risk-taking channel of monetary policy, using more aggregate data. They find that reductions in the federal funds rate increase term spreads and hence the net interest margin for financial intermediaries. The higher net interest margin, which makes financial intermediaries more profitable, is then associated with higher asset growth, and higher asset growth, which they interpret as a shift in credit supply, serves as a prediction for higher real GDP growth.

*5. The zero lower bound constraint on policy interest rates binds more often than expected.*

The constraint that policy interest rates cannot be driven below zero means that conventional expansionary monetary policy becomes ineffective when a sufficiently negative

shock hits the economy so a negative policy rate would be needed to stimulate the economy. This has become known as the zero-lower-bound problem. In this situation, central banks need to resort to other policy measures which have become known as nonconventional policy which involve either 1) managing expectations in order that the policy rate be viewed as staying low for an extended period, thereby lowering long-term interest rates; 2) lowering risk and term premiums by purchasing securities, and thereby changing their relative supply; or 3) by exchange rate interventions aimed at lowering the value of the domestic currency, which would increase foreign demand for domestic production.<sup>4</sup>

Research before the crisis took the view that as long as the inflation objective was around 2%, then the zero-lower-bound constraint on policy interest rates bind infrequently and be short-lived (Reifschneider and Williams (2000) and Coenen, Orphanides and Wieland (2004)). The fact that the Federal Reserve has had to resort to nonconventional monetary policy rate twice in the last ten years (2003-2004 and starting in 2008) and the fact that the federal funds rate, has been at its zero floor for over four years now (since December 2008) with no end in sight, suggests that the zero-lower-bound constraint may bind far more frequently than earlier research suggested, and not be short-lived at all. The flaw with this research is that it was conducted with models that were essentially linear, and, as pointed out above, we now recognise that the macroeconomy is likely to be very nonlinear.

The second reason why it is now clear that the zero lower bound problem is more serious than previously thought is that we now see that contractionary shocks from financial disruptions can be far greater than previously anticipated. Sufficiently large contractionary shocks therefore

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<sup>4</sup> E.g. see Svensson (2001), and Bernanke (2004).

result in the zero lower bound constraint occurring more frequently. The zero-lower-bound on policy rates has therefore become of much greater relevance to central banks than was anticipated before the recent financial crisis.

#### *6. Financial Crises Often Lead to Fiscal Crises*

As pointed out by Reinhart and Rogoff (2009), in the aftermath of financial crises there is almost always a sharp increase in government indebtedness. We have seen this exact situation in the aftermath of the current crisis. The massive bailouts of financial institutions, fiscal stimulus packages, and the sharp economic contractions leading to reductions in tax revenue that occurred throughout the world have adversely affected the fiscal situation in many countries. Budget deficits of over 10% of GDP in advanced countries like the United States have become common, and even countries that prior to the crisis, such as Ireland and Spain, which were held up as paragons of fiscal rectitude because their governments were rapidly reducing the amount of government debt to GDP, have found themselves in dire financial straits, with exploding debt-to-GDP ratios. Furthermore, this rise in indebtedness has the potential to lead to sovereign debt defaults, which has become a huge concern in Europe and still has the potential to cause the demise of the euro, and could even threaten the existence of the European Union if default on their sovereign debt leads to countries being forced to leave the EU.

### **III. CENTRAL BANKING AFTER THE CRISIS**

How do the six facts above change our thinking about the way central banks need to operate in the aftermath of the financial crisis? The first point is one I have discussed more extensively in another paper (Mishkin, 2011): None of the key facts learned from the crisis in any way undermine support for central banks adopt a strong, credible commitment to stabilising inflation in the long run by announcing an explicit, numerical inflation objective, but also having the flexibility to pursue policies aimed at stabilising output around its natural rate level in the short run. In other words, the rationale for flexible inflation targeting is every bit as strong as it was before the crisis. However, the key facts learned from the crisis do suggest that what is meant by flexibility in an inflation targeting regime need to be rethought. There are three areas in which the key facts suggest that central banks need to make major changes in the way they conduct policy: 1) the interaction of monetary and financial stability policies, 2) nonconventional monetary policy, 3) risk management, and 4) fiscal dominance and monetary policy.

### **Interaction of Monetary and Financial Stability Policies**

As discussed earlier, central banks operated under a view that there was a dichotomy between monetary and financial stability policies, with monetary policy focused solely on stabilizing inflation and output and not on promoting financial stability. Three of the key facts discussed above indicate that this view based on the dichotomy of monetary and financial stability policies is no longer tenable. The fact that price and output stability do not ensure financial stability, that low interest rates can encourage excessive risk taking and that disruptions to financial markets have a very negative impact on economic activity for a long period of time, all suggest that monetary policy may have to be adjusted to promote financial stability.

To see why, we need to examine the origins of financial instability. Although there has been much attention in the literature focused on the role of asset bubbles in promoting financial instability, as I have argued elsewhere (e.g., Mishkin and White, 2003, Mishkin, 2011b) asset bubbles by themselves do not lead to financial disruptions. It is only when asset price bubbles interact with the financial sector to produce what I will refer to as a *credit-driven bubble*, that is a credit boom that is divorced from fundamentals, that financial disruptions arise.

With this type of bubble, there is the following typical chain of events: as a result of either exuberant expectations about economic prospects or structural changes in financial markets, a credit boom begins, increasing the demand for some assets and thereby raising their prices. The rise in asset values, in turn, encourages further lending against these assets, increasing demand, and hence their prices, even more. This feedback loop can generate a bubble, and the bubble can cause credit standards to ease as lenders become less concerned about the ability of the borrowers to repay loans and instead rely on further appreciation of the asset to shield themselves from losses.

At some point, however, the credit-driven bubble bursts. The collapse in asset prices then leads to a reversal of the feedback loop in which loans go sour, lenders cut back on credit supply, the demand for the assets declines further, and prices drop even more. The resulting loan losses and declines in asset prices erode the balance sheets at financial institutions, further diminishing credit and investment across a broad range of assets. The decline in lending depresses business and household spending, which weakens economic activity and increases macroeconomic risk in credit markets. In extreme cases, the interaction between asset prices and the health of financial institutions following the collapse of an asset price bubble results in a full-fledged financial crisis

which endangers the operation of the financial system as a whole.

However, it is important to note that there is a second type of bubble that is far less dangerous, which can be referred to as an *irrational exuberance bubble*. This type of bubble is driven solely by overly optimistic expectations and poses much less risk to the financial system than credit-driven bubbles. For example, the bubble in technology stocks in the late 1990s was not fuelled by a feedback loop between bank lending and rising equity values, so the bursting of the bubble was not accompanied by a marked deterioration in bank balance sheets. The bursting of the tech-stock bubble thus did not have a very severe impact on the economy, and the recession that followed was quite mild.

The distinction between the two types of bubbles indicates that there is a strong case for central banks to pursue policies to restrain credit-driven bubbles, but much less support for central banks to attempt to restrain asset price bubbles if they are not associated with a credit boom. As White (2009) and Mishkin (2011b) have pointed out, it is much easier to identify credit-driven bubbles than it is to identify whether asset prices are deviating from fundamental values. Financial regulators and central banks often have information indicating that lenders have weakened their underwriting standards, that risk premia appear to be inordinately low or that credit extension is rising at abnormally high rates. The argument that it is hard to identify asset price bubbles is therefore not a valid argument against leaning against credit-driven bubbles.

Second, as pointed out in White and Mishkin (2003) when irrational asset bubbles burst, they often do not do severe damage to the economy, but credit-driven bubbles do. Indeed, they lead to a highly nonlinear, over-the-cliff phenomenon in which policies to stimulate economic activity are unable to counter the headwinds in the economy, resulting in a prolonged period of

subpar economic growth. Hence cleaning up after a credit-driven bubble is very costly, providing a strong rationale for central banks to pursue policies to lean against this type of bubble to restrain excessive risk taking.

Although there is a strong case to lean against credit bubbles, what policies will be most effective? First it is important to recognize that the key principle for designing effective policies to lean against credit bubbles is whether they fix market failures. Credit extension necessarily involves risk taking. It is only when this risk taking is excessive because of market failures that credit bubbles are likely to develop. Recognizing that market failures are the problem, it is natural to look to prudential regulatory measures to constrain credit bubbles.

Some of these regulatory measures are simply the usual elements of a well-functioning prudential regulatory and supervisory system. These elements include adequate disclosure and capital requirements, liquidity requirements, prompt corrective action, careful monitoring of an institution's risk-management procedures, close supervision of financial institutions to enforce compliance with regulations, and sufficient resources and accountability for supervisors.

The standard measures mentioned above focus on promoting the safety and soundness of *individual* firms and fall into the category of what is referred to as *micro-prudential supervision*. However, even if individual firms are operating prudently, there still is a danger of excessive risk-taking because of the interactions between financial firms that promote externalities. An alternative regulatory approach, which deals with these interactions, focuses on what is happening in credit markets in the aggregate, referred to as *macro-prudential supervision*.

Macro-prudential regulations can be used to dampen the interaction between asset price bubbles and credit provision. For example, research has shown that the rise in asset values that

accompanies a boom results in higher capital buffers at financial institutions, supporting further lending in the context of an unchanging benchmark for capital adequacy; in the bust, the value of this capital can drop precipitously, possibly even necessitating a cut in lending.<sup>5</sup> One macro-prudential policy that is now being widely discussed as part of the Basel 3 process is to adjust capital requirements to dampen the credit cycle, that is, by raising capital requirements during credit booms and lowering them during busts. Other macro-prudential policies to constrain credit bubbles include dynamic provisioning by banks; lower ceilings on loan-to-value ratios or higher haircut requirements for repo lending during credit expansions; and Pigouvian-type taxes on certain liabilities of financial institutions.<sup>6</sup>

Although macro-prudential supervision should be the first line of defense against credit-driven bubbles, there is still the question whether monetary policy should be used to constrain credit-driven bubbles. There are several objections to doing so. First, if monetary policy is used to lean against credit bubbles, it is a violation of the Tinbergen (1939) principle, because one instrument is being asked to do two jobs: 1) stabilise the financial sector; and 2) stabilise the economy.<sup>7</sup> Given that there is another instrument with which to stabilise the financial sector – macro-prudential supervision – wouldn't it be better to use macro-prudential supervision to deal with financial stability, leaving monetary policy to focus on price and output stability?

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<sup>5</sup> For example, see Kashyap and Stein (2004) and Adrian and Shin (2009).

<sup>6</sup> For example, see Bank of England (2009) and French et al. (2010).

<sup>7</sup> Stabilising the financial sector is not a completely separate objective from stabilising the economy because financial instability leads to instability in economic activity and inflation. However, because the dynamics of financial instability are so different than the dynamics of inflation and economic activity, for the purposes of the Tinbergen principle, promoting financial instability can be viewed as a separate policy objective from stabilising the economy.

This argument would be quite strong if macro-prudential policies were able to do the job. However, there are doubts on this score. Prudential supervision is subject to more political pressure than monetary policy because it affects the bottom line of financial institutions more directly. Thus they have greater incentives to lobby politicians to discourage macro-prudential policies that would rein in credit bubbles. After all, during a credit bubble financial institutions make the most money, and they therefore have greater incentives and more resources to lobby politicians to prevent restrictive macro-prudential policies. A case in point is the recent Basel III accord. Implementation of the accord was put off for ten years, and it did not contain measures to deal with systemic risk considerations such as having higher capital requirements on systemically more important financial institutions. This episode suggests that political considerations may make it extremely difficult to have effective macro-prudential supervision.

The possibility that macro-prudential policies may not be implemented sufficiently well to constrain credit bubbles suggests that monetary policy may have to be used instead.<sup>8</sup> But this raises another objection to using monetary policy to lean against credit bubbles: tightening monetary policy may be ineffective in restraining a particular asset bubble because market participants expect such high rates of return from purchasing bubble-driven assets. On the other hand, the evidence relating to the risk-taking channel of monetary policy suggests more strongly that raising interest rates would help restrain lending growth and excessive risk-taking.

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<sup>8</sup> However, as pointed out in Boivin, Lane and Meh (2010), whether monetary policy will be effective in countering financial imbalances depends on the nature of shocks. Boivin, Lane and Meh conduct simulations that show that where financial imbalances reflect specific market failures and regulatory policies can be directed to such failures, monetary policy is less likely to be effective. Monetary policy is likely to be more effective when financial imbalances arise from economy-wide factors.

Furthermore, if a central bank credibly commits to raising interest rates when a credit bubble seems to be forming, then expectations in credit markets will work to make this policy more effective. The expectation that rates will go up with increased risk-taking will make this kind of activity less profitable and thus make it less likely to occur. Furthermore, expectations that rates will rise with increased risk-taking means that interest rates will *not* have to be raised as much to have their intended effect.

Nonetheless, using monetary policy to lean against credit bubbles is not without problems. Doing so could at times result in a weaker economy than the monetary authorities would desire or inflation that falls below its target. This suggests that there is a monetary policy tradeoff between having the inflation forecast at the target and the pursuit of financial stability. Also, having monetary policy focus on financial stability might lead to confusion about the central bank's commitment to the inflation target, with potentially adverse effects on economic outcomes.

Another danger from having monetary policy as a tool to promote financial stability is that it might lead to decisions to tighten monetary policy when it is not needed to constrain credit bubbles. A situation of low interest rates does not necessarily indicate that monetary policy is promoting excessive risk taking. One lesson from the analysis here is that policymakers, and especially monetary policymakers, will want tools to assess whether credit bubbles are developing. Research is underway (e.g, see Borio and Lowe, 2002, and Adrian and Shin, 2010) to find measures will signal if credit bubbles are likely to be forming. High credit growth, increasing leverage, low risk spreads, surging asset prices and surveys to assess if credit underwriting standard are being eased are pieces of data that can help central banks decide if there is imminent danger of credit bubbles. Monitoring of credit market conditions will become

an essential activity of central banks in the future and research on the best ways of doing so will have a high priority in the future.

The discussion above indicates central banks can no longer take the view that there is a dichotomy between monetary and financial stability policies. If macro-prudential policies are implemented to restrain a credit bubble, they will slow credit growth and will slow the growth of aggregate demand. In this case, monetary policy may need to be easier in order to offset weaker aggregate demand. Alternatively, if policy rates are kept low to stimulate the economy, as is true currently, there is a greater risk that a credit bubble might occur. This may require tighter macro-prudential policies to ensure that a credit bubble does not develop. Coordination of monetary and macro-prudential policies becomes of greater value when all three objectives of price stability, output stability and financial stability are to be pursued.

The benefits of coordination between monetary policy and macro-prudential policy provide another reason for having central banks take on the systemic regulator role besides the ones I discussed in Mishkin (2009c) and in French et al. (2010)). Coordination of monetary policy and macropudential policy is more likely to be effective if one government agency is in charge of both. Coordination of policies is extremely difficult when different entities control these policies. Indeed, in the aftermath of the financial crisis, we have seen a movement to put macro-prudential policies under the control of central banks. Dodd-Frank now specifies that the Federal Reserve will become a systemic regulator, while proposals for a banking union in Europe have the European Central Bank taking on the bank supervision role from national regulators.

## **Nonconventional Monetary Policy**

During normal times, the monetary authorities conduct monetary policy using conventional tools, principally by conducting open market operations in short-term government debt in order to set a short-term policy rate, e.g., the federal funds rate in the United States. However, for two reasons financial crises require central banks to adopt non-interest rate tools, which are referred to as *nonconventional monetary policy*. First, financial disruptions cause specific credit markets to seize up and so policy measures directed specifically at these markets are needed to keep these markets functioning. Second, the negative shock to the economy leads to the zero-lower-bound problem where conventional monetary policy is no longer operational because the monetary authorities cannot drive the policy interest rate below zero. Non-conventional monetary policy takes four forms: 1) liquidity provision in which central banks expand lending to both banks and other financial institutions; 2) asset purchases of both government securities and private assets to lower borrowing costs for households; 3) quantitative easing, in which central banks greatly expand their balance sheets; and 4) management of expectations, which involves central banks committing to keeping their policy rate at very low levels for a long period of time.

### *Liquidity Provision*

The first set of tools, liquidity provision, was the primary way that central banks tried to keep specific financial markets functioning. To see how this worked, let's look at the Federal Reserve's measures for liquidity provision. At the outset of the crisis in mid-August 2007, the Fed lowered the discount rate (the interest rate on loans it makes to banks) to 50 basis points (0.50

percentage points) above the federal funds rate target from the normal 100 basis points. It then lowered it further in March 2008 to only 25 basis points above the federal funds rate target. However, borrowing from the discount window has a “stigma” because it suggests that the borrowing bank may be desperate for funds and thus in trouble, and this limited its effectiveness during the crisis. To encourage additional borrowing, in December 2007 the Fed set up a temporary Term Auction Facility (TAF) in which it made loans at a rate determined through competitive auctions. It was more widely used than the discount window facility because it enabled banks to borrow at a rate less than the discount rate, and it was determined competitively, rather than being set at a penalty rate. The TAF auctions started at amounts of \$20 billion, but as the crisis worsened, the Fed raised the amounts dramatically, with a total outstanding of over \$400 billion. (The European Central Bank conducted similar operations, with one auction in June of 2008 of over 400 billion euros.) The Fed then broadened its provision of liquidity to the financial system well outside of its traditional lending to banking institutions. These actions included lending to investment banks, and lending to promote purchases of commercial paper, mortgage backed-securities, and other asset-backed securities. In addition, the Fed engaged in lending to J.P. Morgan to assist in its purchase of Bear Stearns and to AIG to prevent its failure.

The enlargement of the Fed’s lending programs during the 2007–2009 financial crisis was indeed remarkable, expanding the Fed’s balance sheet by over one trillion dollars by the end of 2008, with the balance-sheet expansion continuing into 2009. The number of new programs over the course of the crisis spawned a whole new set of abbreviations, including the TAF, TSLF, PDCF, AMLF, MMLFF, CPFF, and TALF.

In evaluating liquidity provision, some research argues that these types of programmes

had little effect. Taylor and Williams (2009), for example, do not find that the actual lending from the Term Auction Facility (TAF) had any impact on easing credit markets. Other research challenges this conclusion by arguing that financial markets would react to the announcements of programmes rather than the actual lending, and that the dependent variable in the analysis should use changes in spreads and not levels. McAndrews, Sarkar and Wang (2008) find that announcements about TAF did significantly lower credit spreads, and other research supports the conclusion that the TAF and other credit facilities helped lower interest rates (Wu (2008), Christensen, Lopez and Rudebusch (2009), and Sarkar and Shrader (2010)). Baba and Packer (2009), McAndrews (2009) and Goldberg, Kennedy and Miu (2010) find that the US dollar swap facilities did help improve the performance of the dollar swap markets. Using a similar event-study methodology, Ait-Sahalia et al. (2010) find that liquidity provision, not only in the United States but also in the United Kingdom and Japan, did help lower interbank risk premiums. This research suggests that liquidity provision did help stabilise financial markets during this crisis.

### *Large -Scale Asset Purchases*

The second set of nonconventional monetary policy tools involves large-scale asset purchases to lower interest rates on particular types of assets. In November 2008, the Federal Reserve set up a Government Sponsored Entities Purchase Program in which the Fed eventually purchased \$1.25 trillion of mortgage-backed securities (MBS) guaranteed by Fannie Mae and Freddie Mac. Through these purchases, the Fed hoped to prop up the MBS market and to lower interest rates on residential mortgages to stimulate the housing market. This program was dubbed

*QE1* (which stands for Quantitative Easing 1) because it resulted in a substantial expansion of the Fed's balance sheet. Then in November of 2010, the Fed announced that it would purchase \$600 billion of long-term Treasury securities at a rate of about \$75 billion per month. This purchase program which became known as *QE2* was intended to stimulate the economy by lowering long-term interest rates which are more relevant to household and business spending decisions. In September 2011, the Fed implemented a program similar to the Operation Twist program in the 1960s (called the Maturity Extension Program and Reinvestment Policy) to achieve lower long-term rates, in which it would eventually purchase \$667 billion of long-term Treasuries by the end of 2012 while selling an equivalent amount of short-term Treasuries. Most recently the Fed announced in September 2012 an open-ended *QE3* program in which it would buy \$40 billion of MBS per month.

Research on the impact of the Federal Reserve's large-scale asset purchases during the global financial crisis by Gagnon, Raskin, Remache and Sack (2011) finds that these programmes lowered 10-year U.S. Treasury bond rates by a cumulative 91 basis points and lowered long-term mortgage-backed (MBS) and agency securities by even further (113 and 156 basis points respectively) by improving liquidity in these markets.

Although large-scale asset purchases can stimulate the economy by lowering interest rates on these assets, they are not without costs. First, because these asset market purchases were for long-term securities, this exposes the central bank to interest risk (and credit risk if it buys private securities such as mortgage-backed securities) because these securities can have substantial price fluctuations. Possible losses on these securities thus mean that there could be an erosion of capital in the central bank's balance sheet, and this could subject it to Congressional or parliamentary

criticism and actions that could weaken its ability to conduct an independent monetary policy. In addition, if a central bank has bought private securities, their presence on the balance sheet means that the central bank has encroached on the politicians' turf, because the central bank has engaged in a form of fiscal policy, which makes its political position more precarious, again possibly leading to a loss of independence.<sup>10</sup>

Purchase of long-term government securities can pose a danger for central banks because it may create the perception that the central bank is willing to accommodate irresponsible fiscal policy by monetising the debt. This is a particular concern right now in the euro area, where the ECB has purchased securities issued by governments that have large fiscal imbalances. This problem is also a serious concern in the United States, where both political parties have been unwilling so far to address long-run trends in entitlements that could cause US government debt to explode. Not only can the purchase of long-term government assets encourage fiscal profligacy, but it can also lead to an unhinging of inflation expectations, which could make it difficult for the central bank to control inflation in the future.<sup>11</sup>

### *Quantitative Easing*

The result of these programs of liquidity provision and asset purchases resulted in an unprecedented expansion of the Federal Reserve's balance sheet, from \$800 billion before the

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<sup>10</sup>A particular problem for the Federal Reserve is that its holdings of MBSs on its balance sheet directly involve it in the most politicized financial market in the United States. As discussed in Mishkin (2011), this could lead to politicians viewing the Federal Reserve as personally responsible for developments in the housing markets, which could expose it to increased political criticism and pressure on its policy decisions, thereby further weakening its independence.

<sup>11</sup> See Cochrane (2010) for a discussion of how recent fiscal events could lead to a rise in inflation expectations.

financial crisis began in September of 2007 to nearly \$3 trillion as of November 2012. We have seen that this expansion of the balance sheet became known as *quantitative easing* because it led to a huge increase in the monetary base. Because this increase in the monetary base in normal circumstances result in an expansion of the money supply, it could possibly produce inflation down the road.

There are reasons to be very skeptical of the efficacy of pure quantitative easing as are outlined in Curdia and Woodford (2010) and Woodford (2012). First, the huge expansion in the Fed's balance sheet and the monetary base did not result in a large increase in the money supply because most of it just flowed into holdings of excess reserves. Second, because the federal funds rate had already hit the zero-lower bound when it fell to zero, the expansion of the balance sheet and the monetary base could not lower short-term interest rates any further and thereby stimulate the economy. Third, the increase in the monetary base does not mean that banks will increase lending because they can just add to their holdings of excess reserves instead of making loans and this is exactly what appears to have happened in recent years. A similar phenomenon seems to have occurred when the Bank of Japan engaged in quantitative easing after the bubble burst in the stock and real estate markets and yet not only did the economy not recover, but inflation even turned negative (Kuttner, 2004).

Does skepticism about quantitative easing mean that the Fed's nonconventional monetary policy actions that expanded the balance sheet would be ineffective at stimulating the economy? The answer, I believe is no for two reasons. First, as Chairman Bernanke repeatedly argued during the crisis, the Fed's policies were not directed at expanding the Fed's balance sheet, but rather were directed at *credit easing*, that is, altering the composition of the Fed's balance sheet

in order to improve the functioning of particular segments of the credit markets. When the Fed provides funds to a particular segment of the credit market that has seized up, it can help unfreeze the market and thereby enable it again allocate capital to productive uses, thereby stimulating economic activity. Asset purchases might also work by increasing the demand for these securities, thereby lowering the interest rates on those assets relative to other securities and stimulating spending. For example, the purchase of agency and MBS securities, which Gagnon, Raskin, Remache and Sack (2011) found led to over a 100 basis point decline in their interest rates, likely led to a substantial reduction in mortgage rates, thereby spurring the demand for residential housing.

As discussed in Woodford (2012), there are reasons to be skeptical that asset purchases can affect interest rate spreads when markets are functioning normally. Indeed, papers such as Bauer and Rudebusch (2011) and Krishnamurthy and Vissing-Jorgensen (2011) suggest that most of the affect of asset purchase on interest rates operate by affecting expectatoons of future policy, which is the nonconventional monetary policy that we address in the next subsection.

### *Management of Expectations*

Another way for a central bank to lower long-term interest rates to stimulate the economy is to manipulate expectations of the future path of the policy interest rate, a nonconventional monetary policy tool that Michael Woodford (2003) has characterized as *management of expectations*. One such example is the Federal Reserve's announcement in December of 2008 that it expected to keep the federal funds rate near zero for an extended period of time, later extended to mid 2015. This announcement would lower long-term interest rates through the

mechanism provided by the expectations hypothesis of the term structure in which long-term interest rates will equal an average of the short-term interest rates that markets expect to occur over the life of the long-term bond. By committing to the future policy action of keeping the federal funds rate at zero for an extended period, the Fed could lower the market's expectations of future short-term interest rates, thereby causing the long-term interest rate to fall.

There are two types of commitments to future policy actions: conditional and unconditional. The commitment to keep the federal funds rate at zero for an extended period starting in 2008 was *conditional* because it mentioned that the decision was predicated on a weak economy going forward. If economic circumstances changed, the FOMC was indicating that it might abandon the commitment. Alternatively, the Fed could have made an *unconditional* commitment by just stating that it would keep the federal funds rate at zero for an extended period without indicating that this decision was based on the state of the economy. An unconditional commitment has the advantage that it is stronger than a conditional commitment because it does not suggest that the commitment will be abandoned and so is likely to have a larger effect on long-term interest rates. Unfortunately, it has the disadvantage that even if circumstances change so that it would be better to abandon the commitment, the central bank may feel it cannot go back on its word and do so.

The problem of a commitment being seen as unconditional is illustrated by the Fed's experience in the 2003 to 2006 period. In 2003, the Fed became worried that inflation was too low and that there was a significant probability of a deflation occurring. At the August 12, 2003 FOMC meeting, the FOMC statement said, "In these circumstances, the Committee believes that policy accommodation can be maintained for a considerable period." Then when the Fed

started to tighten policy at its June 30, 2004 FOMC meeting, it changed its statement to say that , “policy accommodation can be removed at a pace that is likely to be measured.” Then for the next ten FOMC meetings through June of 2006, the Fed raised the federal funds rate target by exactly  $\frac{1}{4}$  percentage points at every single meeting. Many market participants interpreted the FOMC’s statements as indicating an unconditional commitment, and this is why the Fed may have been constrained not to deviate from  $\frac{1}{4}$  percentage point moves at every FOMC meeting. In retrospect, this constraint may have led to monetary policy that was too easy for too long, with inflation subsequently rising to well above desirable levels, and, as discussed earlier, it may have lead to excessive risk-taking through the risk-taking channel of monetary policy.

The problem with unconditional policy commitments suggest that commitments should be conditional, but this raises the crucial question of *conditional on what*. Eggertson and Woodford (2003, 2004) and Woodford (2012) argue convincingly when there is a zero-lower-bound problem, the policy commitment should be conditional on a target criterion that makes monetary policy history dependent in a particular way. The policy path will have to be more accommodative than would otherwise be the case if a zero-lower bound had not occurred so that the expectation of the easier policy will mitigate the effect of the zero interest rate being too high when the zero-lower-bound constraint binds. Specifically, Eggertsson and Woodford (2003, 2004) suggests that the policy rate should be kept at its floor of zero until the price level reaches a path of an output-adjusted price level which is the log of a price index plus the output gap multiplied by a coefficient (which reflects the relative weight on output-gap versus inflation stabilization). Because this concept of an “output-gap adjusted price level” might be somewhat hard for the public to understand, Woodford (2012) suggests that a simpler criterion that would

work nearly as well would be to have the target criterion be a nominal GDP path which grows at the inflation target rate (e.g., 2% for the Fed) multiplied by the growth rate of potential GDP and starts at the level that was reached when the zero-lower-bound constraint first appeared (around the end of 2008 in the United States.) (If potential GDP growth was estimated to be 2% annual rate, this would imply a growth rate of the nominal GDP path at a 4% annual rate.)

This proposal has several advantages over other target criterion, for example, the 7% unemployment rate and 3% inflation thresholds at which the policy rate would be raised outlined by the president of the Federal Reserve Bank of Chicago, Charles Evans, described in Campbell, Evans, Fisher and Justiano (2012), or proposals to raise the inflation target to 4%, as discussed by Blanchard, Dell’Ariccia and Maura (2010) and Rogoff (2011). There are two problems with either of these proposals. First neither is history dependent because they are completely forward looking. Hence if negative shocks to the economy sent output and inflation further below the target path, neither of these policies would lead to a lengthening of the time period where the policy rate would remain at zero, as would be optimal.

The second problem with proposals like this is that they could unhinge long-run inflation expectations. If a central bank suggests that it is OK for inflation to rise above its initial target level, the public may come to believe that price stability is no longer a credible goal of the central bank and then the question arises, “if a 3 or 4% level of inflation is OK, then why not 6%, or 8%, and so on.” The target criterion proposed by Eggertsson and Woodford (2003, 2004) or Woodford (2012) does not have this feature because it continues the central bank’s commitment to a long-run inflation target, say of 2%. It does allow inflation to *temporarily* rise above the 2% target level, but makes clear that the long-run inflation objective is unchanged and that once the

zero-lower-bound constraint is no longer binding, then the central bank returns to a conventional, forward-looking, flexible inflation target regime in which the central bank seeks to achieve the inflation target of 2% over the medium term.

There still are formidable challenges to a central bank's adopting a conditional commitment based on a nominal GDP path. First, it may be more difficult to explain to the public and financial market participants. An inflation target is much simpler to explain than a target path, particularly one that involves nominal GDP, which is a concept that the public is much less familiar with. Second, when inflation temporarily rises above the 2% inflation, as the central bank intends, the central bank will have to carefully explain that it is not weakening its commitment to the long-run 2% inflation target. Third, a nominal GDP path requires that the central bank take a stance on the number for the growth rate of potential GDP, a number on which there is a great deal of uncertainty. This last problem would be particularly severe if the central bank ignored what was actually happening to inflation in estimating the output gap, a mistake that the Federal Reserve made in the 1970s.

Although these challenges are serious ones, in the current environment central banks may have little choice. As discussed above, in the current environment, large-scale asset purchases may only be effective by affecting expectations of future policy rates. If this is the case, management of expectations at the zero-lower bound is the only effective monetary policy tool that the central bank has at its disposal. This is particularly relevant currently (at the time of this writing, November 2012) because the economy in both in the United States and Europe is quite weak and indeed, there are major downside risks from the fiscal cliff in the United States and the possibility of financial disruption in Europe if there is a breakup of the Eurozone.

Large-scale asset purchases may have an important role in managing expectations. An announcement of a policy commitment to manage expectations may not be sufficiently credible because talk is cheap. As we have seen, large-scale asset purchase are impose costs on a central bank and so combining the announcement of the policy commitment with large-scale asset purchases may make the policy commitment more credible because the central bank has in effect put its money where its mouth is.

## **Risk Management and Gradualism**

The standard models at central banks assume that the economy is linear. With a quadratic objective function, the optimal policy is therefore certainty equivalent: it can be characterised by a linear time-invariant response to each shock, and the magnitude of these responses does not depend on the variances or on any other aspect of the probability distribution of the shocks. In such an environment, optimal monetary policy does not focus on tail risk, which might require risk management. Furthermore, when financial market participants and wage and price setters are relatively forward-looking, the optimal policy under commitment is characterised by considerable inertia, which is commonly referred to as gradualism.<sup>11</sup>

In the United States, as well as in many other industrial economies, the actual course of monetary policy before the crisis was typically very smooth. For example, the Federal Reserve usually adjusted the federal funds rate in increments of 25 or 50 basis points (that is,  $\frac{1}{4}$  or  $\frac{1}{2}$  percentage point) and sharp reversals in the funds rate path were rare. Numerous empirical

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<sup>11</sup>The now-classic reference on this approach is Woodford (2003). Also see Goodfriend and King (1997); Rotemberg and Woodford (1997); Clarida, Gali and Gertler (1999); King and Wolman (1999); Erceg, Henderson and Levin (2000); Benigno and Woodford (2003); Giannoni and Woodford (2005); Levin, Onatski and Williams (2005); and Schmitt-Grohé and Uribe (2005).

studies have characterised monetary policy before the crisis using Taylor-style rules, in which the policy rate responds to the inflation gap and the output gap; these studies have generally found that the fit of the regression equation is improved by including a lagged interest rate that reflects the smoothness of the typical adjustment pattern.<sup>12</sup>

Although the linear-quadratic framework might be reasonable under normal circumstances, we have learned that financial disruptions can make the macro economy highly non-linear. These nonlinearities suggests that policy-makers should not only focus on the modal outcomes, as they would in a certainty equivalent world which is a feature of the linear-quadratic framework, but should also tailor their policies to cope with uncertainty and with the possible existence of tail risks in which there is a low probability of extremely adverse outcomes. I have argued elsewhere (Mishkin (2010b)) that the importance of financial frictions and nonlinearities in the economy provides a rationale for a particular form of risk management approach to monetary policy in which monetary policy would act pre-emptively when financial disruptions occur. Specifically, monetary policy would move quickly to reduce the policy rate rapidly in order to decrease the probability that a financial disruption will cause significant deterioration in the real economy through the adverse feedback loop described earlier, in which the financial disruption causes a worsening of conditions in the credit markets, which causes the economy to deteriorate further, causing a further worsening of conditions in the credit markets, and so on. In so doing, monetary policy could reduce the likelihood of a financial disruption setting off an adverse feedback loop. The resulting reduction in uncertainty could then make it easier for the markets to collect the information that facilitates price discovery, thus hastening the return of normal market functioning.

The above policy approach is one in which gradualism is abandoned. To achieve normal market functioning most effectively, monetary policy would be timely, decisive, and flexible. First, *timely action*, which is pre-emptive, is particularly valuable when an episode of financial instability becomes sufficiently severe to threaten the core macroeconomic objectives of the central bank. In such circumstances, waiting too long to ease policy could result in further deterioration of the macroeconomy and might well increase the overall amount of easing that

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<sup>12</sup> See Clarida, Gali and Gertler (1998, 2000); Sack (2000); English, Nelson and Sack (2003); Smets and Wouters (2003); Levin, Onatski and Williams (2005). Further discussion can be found in Bernanke (2004).

would eventually be required to restore the economy to health. When financial markets are working well, monetary policy can respond primarily to the incoming flow of economic data about production, employment, and inflation. In the event of a financial disruption, however, pre-emptive policy would focus on indicators of market liquidity, credit spreads, and other financial market measures that can provide information about sharp changes in the magnitude of tail risk to the macroeconomy. Indeed, even if economic indicators were strong, monetary policy would act to offset the negative impact of the financial disruption.

Second, policy-makers would be prepared for *decisive action* in response to financial disruptions. In such circumstances, the most likely outcome (the modal forecast) for the economy may be fairly benign, but there may also be a significant risk of more severe adverse outcomes. In this situation the central bank can take out insurance by easing the stance of policy further than if the distribution of probable outcomes were perceived as fairly symmetric around the modal forecast. Moreover, in such circumstances, the monetary policy authorities can argue that these policy actions do not imply a deterioration of the central bank's assessment of the most likely outcome for the economy, but rather constitute an appropriate form of risk management that reduces the risk of particularly adverse outcomes.

Third, *policy flexibility* is especially valuable throughout the evolution of a financial market disruption. During the onset of the episode, this flexibility may be evident from the decisive easing of policy that is intended to forestall the contractionary effects of the disruption and provide insurance against the downside risks to the macroeconomy. However, it is important to recognise that in some instances financial markets can also turn around quickly, thereby reducing the drag on the economy as well as the degree of tail risk. Therefore, the central bank would monitor credit spreads and other incoming data for signs of financial market recovery and, if necessary, take back some of the insurance; thus, at each stage of the episode, the appropriate monetary policy may exhibit much less smoothing than would be typical in other circumstances. The risk management approach outlined here is one that abandons the prescription of the linear-quadratic framework that the optimal monetary policy would involve gradual changes. Instead, with this approach aggressive actions by central banks to minimise macroeconomic risk would result in pre-emptive, large changes in monetary policy. This was an important feature of the conduct of conventional monetary policy by the Federal Reserve during the crisis. In September

2007, just after the initial disruption to financial markets in August, the Federal Reserve lowered the federal funds rate target by 50 basis points (0.5 percentage point) even though the economy was displaying substantial positive momentum, with real GDP growth quite strong in the third quarter. The Federal Reserve was clearly not reacting to current economic conditions, but rather to the downside risks to the economy from the financial disruption. Subsequently, the Federal Reserve very rapidly brought the federal funds rate target from its level of 5¼% before the crisis, in September 2007, to 2% in April 2008. Then, after the Lehman Brothers collapse in September 2008, the Federal Reserve began another round of rapid interest rate cuts, with the federal funds rate target lowered by 75 basis points in December 2008, bringing it down to the zero lower bound. Clearly, the Federal Reserve had abandoned gradualism.<sup>13</sup>

One danger from aggressive, pre-emptive actions that are taken as part of the risk management approach is that they might create the perception that the monetary policy authorities are too focused on stabilising economic activity and not enough on price stability. If this perception occurs, the pre-emptive actions might lead to an increase in inflation expectations. The flexibility to act pre-emptively against a financial disruption presupposes that inflation expectations are well anchored and unlikely to rise during a period of temporary monetary easing. To work effectively, the risk management approach outlined here thus requires a commitment to a strong nominal anchor. A risk management approach therefore provides an additional rationale for a flexible inflation targeting framework, and, as I have argued elsewhere

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<sup>13</sup>One period before the crisis when the Federal Reserve abandoned gradualism was during the LTCM (Long-Term Capital Management) episode, when it lowered the federal funds rate target by 75 basis points within a period of a month and a half in the autumn of 1998. This action fits into the risk management approach described here. However, once the shock dissipated, the Federal Reserve did not take away the insurance provided by the funds rate cuts, as the risk management approach outlined here suggests would have been appropriate. I consider this to be one of the serious monetary policy mistakes made by the Federal Reserve under Greenspan. Not only did inflation subsequently rise above the desired level, but the actions also indicated that the Federal Reserve would react asymmetrically to shocks, lowering interest rates in the event of a financial disruption, but not raising them upon reversal of the adverse shock. This helped contribute to the belief in the “Greenspan put” in which the Greenspan Fed cleaned up after financial disruptions like the LTCM and Russian defaults in the fall of 2008 by lowering interest rates, leading to a form of moral hazard in which financial institutions expect monetary policy to help them recover from bad investments (e.g. see Tirole and Farhi 2009, Keister (2010), and Wilson and Wu (2010)).

(Mishkin (2008)), a strong nominal anchor can be especially valuable in periods of financial market stress, when prompt and decisive policy action may be required as part of a risk management approach in order to forestall an adverse feedback loop.

## **Fiscal Dominance and Monetary Policy**

The key fact driven home by the recent financial crisis that financial crises are often followed by fiscal crises indicates that the view that “Inflation is always and everywhere a monetary phenomenon” requires modification. Before the crisis, central banks, at least in advanced countries, could take the view that governments would pursue long-run budget balance so that the amount of government debt to GDP would be at sustainable levels. In the aftermath of the crisis, we have seen a huge explosion in government debt, either because of decreased revenue and increased government spending to stimulate the economy, as in the United States, or because of bailouts of the financial sector, as in Ireland and Spain. This has raised the prospect that governments may no longer be able or willing to pay for their spending with future taxes. Either this means that the government’s intertemporal budget constraint will have to be satisfied by issuing monetary liabilities or, alternatively, by a default on the government debt.

This situation in which government budget deficits are out of control is described as *fiscal dominance*, because the monetary authorities no longer will be able to pursue monetary policies that will keep inflation under control. If a default occurs, the resulting collapse in the value of the domestic currency leads to high inflation, and this is the experience we have seen in many emerging market countries, with Argentina in 2002 being one recent prominent example. Even when countries are in a currency union where they do not have their own currency, default is likely to lead to an expulsion from the currency union and the subsequent depreciation of the newly created domestic currency will then result in high inflation. Indeed, this is the prospect that currently faces Greece, where a disorderly default would result in an exit from the Eurozone,

with not only high inflation but also a total collapse of the banking system.

If default does not occur, fiscal dominance still results in high inflation even if the central bank does not want to pursue inflationary policies and has a strong commitment to an inflation target. It is still true that inflation will have a monetary element because high-powered money will increase, so in that sense, the famous adage is still true, this is a situation that Sargent and Wallace (1981) in their famous paper described as “unpleasant monetarist arithmetic”. Fiscal dominance will at some point in the future force the central bank to monetize the debt and so even tight monetary policy in the present will not prevent inflation. Indeed, as Sargent and Wallace (1981) points out, tight monetary policy might result in inflation being even higher.

To see how this would play out in the current context, we need to recognize that fiscal dominance puts a central bank between a rock and a hard place. If the central bank does not monetize the debt, then interest rates on the government debt will rise sharply, causing the economy to contract. Indeed, without monetization fiscal dominance may result in the government defaulting on its debt, which would lead to a severe financial disruption, leading to an even more severe economic contraction. Hence the central bank will in effect have little choice and will be forced to purchase the government debt and monetize it, eventually leading to a surge in inflation.

We already are seeing the beginning of this scenario in Europe. The threat of defaults on sovereign debt in countries such as Ireland, Portugal, Spain and Italy led the ECB has led the ECB to purchase individual countries’ sovereign debt, with the latest manifestation the announcement in September 2012 that it will engage in what it has called Outright Monetary Transactions (OMT). These OMT transactions involve purchases of sovereign debt in the secondary markets of these countries subject to their governments accepting a program of conditionality from the European Financial Stability Facility/European Stability Mechanism. The ECB describes these transactions as monetary in nature because they “aim at safeguarding an appropriate monetary policy transmission,” with the reasoning that they are “monetary” because low ECB policy rates are not translating into low interest rates in these countries. Nonetheless, these transactions are in effect monetization of individual countries’ government debt (even if they are sterilized for the Eurosystem as a whole). The ECB’s purchase of individual countries’ sovereign debt arises from the difficult position it faces. If the ECB does

not do what ECB President, Mario Draghi, has described as “doing whatever it takes” to lower interest rates in these countries, the alternative is deep recessions in these countries or outright defaults on their debt that would create another “Lehman moment” in which the resulting financial shock would send the Eurozone over the cliff.

It is true that the ECB’s bond purchasing programs will not result in inflation *if* the sovereigns whose debt is being purchased get their fiscal house in order and so fiscal dominance is avoided. However this is a big *if*. Indeed, there is a danger that Europe may find itself with what I will refer to as the “Argentina problem”. Argentina has had a long history of fiscal imbalances that have led to high inflation, and this continues to this day. The problem in Argentina is that its provinces overspend and are always bailed out by the central government. The result is a permanent fiscal imbalances for the central government which then results in monetization of the debt by the central bank and high inflation. Europe could be facing the same problem. With bailouts of sovereigns in the Eurozone, the incentives to keep fiscal policy sustainable in individual countries has been weakened, leading to a serious moral hazard problem. Budget rules have been proposed to eliminate this moral hazard, but as the violation of the Growth and Stability Pact rules by Germany and France a number of years ago illustrates, these budget rules are very hard to enforce. However, we have seen success in some countries on this score, with Chile being a notable example.

Thus the Eurozone may be on a path to become more like Argentina (which of course is why Germans are horrified), with fiscal dominance a real possibility and high inflation the result. This possibility is a very real one despite what the Maastricht Treaty specifies about the role of the ECB and what policymakers in the ECB want.

Although the United States is not in nearly as dire a situation because the no-bailout policy for state and local governments that has evolved over many years avoids the “Argentina problem”, the possibility of fiscal dominance is real. The U.S. government is fully capable of avoiding fiscal dominance and achieving long-run fiscal sustainability by reigning in spending on entitlements (Medicare/Medicaid and Social Security), while increasing tax revenue (but not necessarily tax rates). Indeed one such plan was proposed by the Simpson-Bowles Commission appointed by President Obama. However, when the Commission’s recommendations were announced, President Obama did not embrace them, nor did the Republican party which refused

to consider any increase in tax revenue. Hopefully, after the recent election, President Obama and the Republicans will be able to come together to implement legislation to achieve long-run fiscal sustainability, but the failure of the Democrats and the Republicans to come up with a compromise before the election was, to say the least, very discouraging.

There has been a great deal of attention paid to the Federal Reserve's quantitative easing policies as a potential threat to price stability in the United States. The concern is that the expansion of the Federal Reserve's balance sheet as a result of quantitative easing will unhinge inflation expectations and thus create inflation in the near future. However, the far greater threat is on the fiscal front. If U.S. government finances are not put on a sustainable path, we could see the scenario I have outlined above, where markets lose confidence in U.S. government debt, so that prices fall and interest rates shoot up, and then the public might expect the Federal Reserve to be forced to monetize this debt. What would then unhinge inflation expectations would be the fear of fiscal dominance, which could then drive up inflation very quickly.

The bottom line is that no matter how strong the commitment of a central bank to an inflation target, fiscal dominance can override it. Without long-run fiscal sustainability, no central bank will be able to keep inflation low and stable. This is why central bankers must lobby both in public and in private to encourage their governments to put fiscal policy on a sustainable path.

#### **IV. CONCLUDING REMARKS**

Events in the recent global financial crisis have changed central banking forever. Although the basic central banking paradigm of flexible inflation targeting in which the central bank makes a credible commitment to stabilize inflation in the long run is still valid, the form of its flexibility requires substantial rethinking. There are four areas in which central banks need to make, and are making, major changes in the way they conduct policy. First, monetary policy at times need to lean against credit-driven bubbles, and there is an interaction of monetary policy with macroprudential policy, in which tighter macroprudential policy will require easier

monetary policy and vice versa. Second, at the current juncture the nonconventional monetary policy of managing expectations is needed to stabilize the economy, but the communications challenges are serious ones. Third, the nonlinearities of the macro economy implies that central banks will need to develop a risk management approach to cope with financial disruptions. Fourth, fiscal dominance is now a big problem in advanced economies and steps must be taken to get countries' fiscal houses in order.

The bottom line is that central banking is now entering a brave new world in which the challenges have become greater and the conduct of policy has become more complex.

## REFERENCES

- Adrian, T. and Shin, H.S. (2009), “Money, Liquidity and Monetary Policy”, *American Economic Review*, Vol. 99, No 2, pp. 600-605.
- Adrian, T. and Shin, H.S. (2010), “Financial Intermediation and Monetary Economics”, *Federal Reserve Bank of New York Staff Report*, No 398 (Revised May).
- Adrian, T., Moench, E. and Shin, H.S. (2010), “Macro Risk Premiums and Intermediary Balance Sheet Quantities”, *Federal Reserve Bank of New York Staff Report*, No 428.
- Ait-Sahalia, Y., Adnritzky, J., Jobst, A., Nowak, S. and Tamirisa, N. (2010), “Market Response to Policy Initiatives During the Global Financial Crisis”, *NBER Working Paper*, No 15809, March.
- Bank of England, “The Role of Macroprudential Policy,” Discussion Paper (November 2009).
- Bauer, M. D. And G.D. Rudebusch (2011) “The Signaling Channel for Federal Reserve Bank Bond Purchases, Federal Reserve Bank of San Francisco Working Paper no. 2011-21, December.
- Bean, C., Paustian, M., Penalver, A. and Taylor, T. (2010), “Monetary Policy After the Fall”, Federal Reserve Bank of Kansas City, Jackson Hole Symposium.
- Benigno, P. and Woodford, M. (2003), “Optimal Monetary and Fiscal Policy: A Linear-Quadratic Approach”, in Gertler, M. and Rogoff, K. (eds.), *NBER Macroeconomics Annual 2003*, MIT Press, Cambridge, Mass., pp. 271-332.
- Bernanke, B.S. (2004), “Gradualism”, speech delivered at an economics luncheon co-sponsored by the Federal Reserve Bank of San Francisco (Seattle Branch) and the University of Washington, held in Seattle, 20 May.
- Bernanke, B.S. (2010), “Monetary Policy and the Housing Bubble”, speech given at the annual meeting of the American Economic Association, Atlanta, Georgia, 3 January 2010, available at <http://www.federalreserve.gov>
- Bernanke, B.S. and Gertler, M. (1999), “Monetary Policy and Asset Price Volatility”, Federal Reserve Bank of Kansas City conference *New Challenges for Monetary Policy*, Kansas City, pp. 77-128.
- Bernanke, B.S. and Gertler, M. (2001), “Should Central Banks Respond to Movements in Asset Prices?” *American Economic Review*, Vol. 91, Papers and Proceedings, May, pp. 253-257.

- Bernanke, B.S., Gertler, M. and Gilchrist, S. (1999), “The Financial Accelerator in a Quantitative Business Cycle Framework”, in Taylor, J.B. and Woodford, M. (eds.), *Handbook of Macroeconomics*, Vol. 1, part 3, North-Holland, Amsterdam, pp. 1341-1393.
- Blanchard, O., Dell’Ariccia, G. and Mauro, P. (2010), “Rethinking Monetary Policy”, *IMF Staff Position Note*, 12 February, SPN/10/03
- Boivin, J., Lane, T. and Meh, C. (2010), “Should Monetary Policy Be Used to Counteract Financial Imbalances?”, *Bank of Canada Review* (Summer), pp. 23-36.
- Borio, C. and Lowe, P. (2002), “Asset Prices, Financial and Monetary Stability: Exploring the Nexus”, *BIS Working Paper*, No 114, Bank for International Settlements, Basel, July.
- Borio, C. and Zhu, H. (2008), “Capital Regulation, Risk-Taking and Monetary Policy: A Missing Link in the Transmission Mechanism?”, *BIS Working Paper*, No 268, December.
- Campbell, J.R., C.L. Evans, J.D.M. Fisher and A. Justiniano (2012) “Macroeconomic Effects of FOMC Forward Guidance,” Federal Reserve Bank of Chicago, manuscript, forthcoming *Brookings Papers on Economic Activity*.
- Christensen, J.H.E., Lopez, J.A. and Rudebusch, G.D. (2009), “Do Central Bank Liquidity Facilities Affect Interbank Lending Rates?” *Federal Reserve Bank of San Francisco Working Paper*, No 2009-13, June.
- Clarida, R., Galí, J. and Gertler, M. (1999), “The Science of Monetary Policy: A New Keynesian Perspective”, *Journal of Economic Literature*, Vol. 37, December, pp. 1661-1707.
- Cochrane, J.H. (2010), “Understanding Policy in the Great Recession: Some Unpleasant Fiscal Arithmetic”, University of Chicago manuscript, 18 October, available at [http://faculty.chicagobooth.edu/john.cochrane/research/papers/understanding\\_policy.pdf](http://faculty.chicagobooth.edu/john.cochrane/research/papers/understanding_policy.pdf)
- Coenen, G., Orphanides, A. and Wieland, V. (2004), “Price Stability and Monetary Policy Effectiveness When Nominal Interest Rates are Bounded at Zero”, *Advances in Macroeconomics*, Vol. 4, No 1.
- Curdia, V. and Woodford, M. (2009), “Credit Spreads and Optimal Monetary Policy”, *Federal Reserve Bank of New York Staff Reports*, No 385.
- Curdia, V. and Woodford, M. (2010), “Conventional and Unconventional Monetary Policy”, *Federal Reserve Bank of St. Louis Review*, July/August, pp. 229-264.
- Eggertsson, G. B. and Woodford, M. (2003), “The Zero Bound on Interest Rates and Optimal Monetary Policy”, *Brookings Papers on Economic Activity*, Vol. 2003, No 1, pp. 139-211.

Eggertsson, G.B. and Woodford, M. (2004), “Policy Options in a Liquidity Trap”, *American Economic Review*, 94(2), pp. 76-79.

English, W.B., Nelson, W.R. and Sack, B.P. (2003), “Interpreting the Significance of the Lagged Interest Rate in Estimated Monetary Policy Rules”, *Contributions to Macroeconomics*, Vol. 3, No 1, article 5.

Erceg, C.J., Henderson, D.W. and Levin, A.T. (2000), “Optimal Monetary Policy with Staggered Wage and Price Contracts”, *Journal of Monetary Economics*, Vol. 46, October, pp. 281-313.

Friedman, M. (1968), “The Role of Monetary Policy”, *American Economic Review*, Vol. 58, March, pp. 1-17.

French, K.R. et al. (2010), *The Squam Lake Report: Fixing the Financial System*, Princeton University Press, Princeton, NJ.

Gagnon, J., Raskin, M., Remache, J. and Sack, B. (2011), “The Financial Market Effects of the Federal Reserve’s Large Scale Asset Purchases,” *International Journal of Central Banking* 7 (1): 3-43.

Gambacorta, L. (2009), “Monetary Policy and the Risk-Taking Channel”, *BIS Quarterly Review*, December, pp. 43-53.

Giannoni, M.P. and Woodford, M. (2005), “Optimal Inflation-Targeting Rules”, in Bernanke, B.S. and Woodford, M. (eds.), *Inflation Targeting*, University of Chicago Press, Chicago, pp. 93-172.

Goldberg, L., Kennedy, C. and Miu, J. (2010), “Central Bank Dollar Swap Lines and Overseas Dollar Funding Costs”, *National Bureau of Economic Research Working Paper*, No 15763, February.

Goodfriend, M. and King, R.G. (1997), “The New Neoclassical Synthesis and the Role of Monetary Policy”, in Bernanke, B.S. and Rotemberg, J.J. (eds.), *NBER Macroeconomics Annual*, MIT Press, Cambridge, Mass., pp. 231-83.

Ioannidou, V., Ongena, S. and Peydro, J-L. (2009), “Monetary Policy, Risk-Taking and Pricing: Evidence from a Quasi-Natural Experiment”, *European Banking Centre Discussion Paper*, No 2009-04S.

Jimenez, G., Ongena, S., Peydro, J-L. and Saurina, J. (2008), “Hazardous Times for Monetary Policy: What Do Twenty-Three Million Bank Loans Say About the Effects

of Monetary Policy on Credit Risk-Taking?”, Working Paper No 0833, Bank of Spain.

Kashyap, A.K. and Stein, J.C. (1994), “Monetary Policy and Bank Lending”, in Mankiw, N.G. (ed.), *Monetary Policy*, National Bureau of Economic Research, Studies in Business Cycles, Vol. 29, University of Chicago Press, Chicago, pp. 221-256.

Keister, T. (2010), “Bailouts and Financial Fragility”, Federal Reserve Bank of New York unpublished manuscript.

King, R.G. and Wolman, A.L. (1999), “What Should the Monetary Authority Do When Prices Are Sticky?”, in Taylor, J. (ed.), *Monetary Policy Rules*, University of Chicago Press, Chicago, pp. 349-398.

Krishnamurthy, A. and A. Vissing-Jorgensen (2011) “The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy,” *Brookings Papers on Economic Activity*, pp. 215-65.

Kuttner, K.N. (2004), “Comment on ‘Price Stability and Japanese Monetary Policy’ by Robert Hetzel”, *Monetary and Economic Studies*, No 22, Bank of Japan Institute for Monetary and Economic Studies, pp. 37-46.

Levin, A.T., Onatski, A., Williams, J.C. and Williams, N. (2005), “Monetary Policy Under Uncertainty in Micro-Founded Macroeconometric Models”, in Gertler, M. and Rogoff, K. (eds.), *NBER Macroeconomics Annual 2005*, MIT Press, Cambridge, Mass., pp. 229-287.

McAndrews, J., Sarkar, A. and Wang, Z. (2008), “The Effect of the Term Auction Facility on the London Inter-Bank Offered Rate”, *Federal Reserve Bank of New York Staff Report*, No. 335, July.

Mishkin, F.S. (1991), “Asymmetric Information and Financial Crises: A Historical Perspective”, in Hubbard, R.G. (ed.), *Financial Markets and Financial Crises*, University of Chicago Press, Chicago, pp. 69-108.

Mishkin, F.S. (2008), “Whither Federal Reserve Communication”, speech delivered at the Peterson Institute for International Economics, Washington, DC, 28 July, available at [www.federalreserve.gov](http://www.federalreserve.gov)

Mishkin, F.S. (2009a), “Will Monetary Policy Become More of a Science?”, in Deutsche Bundesbank (ed.), *Monetary Policy Over Fifty Years: Experiences and Lessons*, Routledge, London, pp. 81-107.

Mishkin, F.S. (2009b), “The Financial Crisis and the Federal Reserve”, *NBER Macro Annual, 2009*, pp. 495-508.

Mishkin, F.S. (2010a), “Monetary Policy Flexibility, Risk Management, and Financial Disruptions”, *Journal of Asian Economics*, No 23, June, pp. 242-246.

Mishkin, Frederic S. (2010b) “Will Monetary Policy Become More of a Science?” in Deutsche Bundesbank, ed., *Monetary Policy Over Fifty Years: Experiences and Lessons* (Routledge: London 2009), pp. 81-107. Reprinted in Volcker Wieland, Editor, *The Science and Practice of Monetary Policy Today* (Springer-Verlag: Berlin, 2010), pp. 81-103.

Mishkin, F.S. (2011a), “Over the Cliff: From the Subprime to the Global Financial Crisis”, *Journal of Economic Perspectives*, Vol. 25, No. 1 (Winter), pp. 49-70.

Mishkin, Frederic S. (2011b) “Monetary Policy Strategy: Lessons From the Crisis” in Marek Jarocinski, Frank Smets and Christian Thimann, eds. *Monetary Policy Revisited: Lessons from the Crisis*, Sixth ECB Central Banking Conference (European Central Bank: Frankfurt), pp. 67-118

Posen, A.S. (2009), “Finding the Right Tool for Dealing with Asset Price Booms”, speech to the MPR Monetary Policy and the Markets Conference, London, 1 December, available at <http://www.bankofengland.co.uk>

Rajan, R.G. (2005), “Has Financial Development Made the World Riskier?”, *The Greenspan Era: Lessons for the Future*, Federal Reserve Bank of Kansas City, Kansas City, pp. 313-369.

Rajan, R. (2006), “Has Finance Made the World Riskier?”, *European Financial Management*, Vol. 12, No 4, pp. 499-533.

Reifschneider, D., Tetlow, R. and Williams, J. (1999), “Aggregate Disturbances, Monetary Policy, and the Macroeconomy: The FRB/US Perspective”, *Federal Reserve Bulletin*, Vol. 85, January, pp. 1-19.

Reinhart, C.M. and Reinhart, V.R. (2010), “After the Fall”, *Macroeconomic Challenges: The Decade Ahead*, Federal Reserve Bank of Kansas City Economic Symposium, manuscript available at <http://www.kansascityfed.org>

Reinhart, C.M and Rogoff, K.S. (2009), *This Time Is Different: Eight Centuries of Financial Folly*, Princeton University Press, Princeton, NJ.

Rogoff, K. (2011) “The Bullet is Yet to be Fired to Stop the Crisis,” *Financial Times*, August 8.

Rotemberg, J. and Woodford, M. (1997), “An Optimization-Based Econometric Framework for the Evaluation of Monetary Policy”, in Bernanke, B.S. and Rotemberg, J.J. (eds.), *NBER Macroeconomics Annual 1997*, MIT Press, Cambridge, Mass., pp. 297-346.

- Sack, B. (2000), “Does the Fed Act Gradually? A VAR Analysis”, *Journal of Monetary Economics*, Vol. 46, August, pp. 229-256.
- Sarkar, A. and Shrader, J. (2010), “Financial Amplification Mechanisms and the Federal Reserve’s Supply of Liquidity During the Crisis”, *Federal Reserve Bank of New York Staff Report*, No 431, March.
- Sargent, T.J and N. Wallace (1981) “Some Unpleasant Monetarist Arithmetic,” Federal Reserve Bank of Minneapolis, *Quarterly Review* (Fall), pp. 1-17.
- Schmitt-Grohé, S. and Uribe, M. (2005), “Optimal Fiscal and Monetary Policy in a Medium-Scale Macroeconomic Model”, in Gertler, M. and Rogoff, K. (eds.), *NBER Macroeconomics Annual 2005*, MIT Press, Cambridge, Mass., pp. 383-425.
- Smets, F. and Wouters, R. (2003), “An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area”, *Journal of the European Economic Association*, Vol. 1, September, pp. 1123-1175.
- Svensson, L.E.O. (1999), “Price-Level Targeting Versus Inflation Targeting: A Free Lunch”, *Journal of Money, Credit and Banking*, No 31, pp. 277-295.
- Svensson, L.E.O. (2001), “The Zero Bound in an Open Economy: A Foolproof Way of Escaping from a Liquidity Trap”, *Monetary and Economic Studies*, Vol. 19, No S1, pp. 277-312
- Svensson, L.E.O. (2002), “Monetary Policy and Real Stabilization”, *Rethinking Stabilization Policy*, Federal Reserve Bank of Kansas City Jackson Hole Symposium, pp. 261-312.
- Taylor, J. (2007), “Housing and Monetary Policy”, *Housing, Housing Finance and Monetary Policy*, Federal Reserve Bank of Kansas City, Kansas City, pp. 463-476.
- Taylor, J.B. (2009), *Getting Off Track: How Government Actions and Interventions Caused, Prolonged and Worsened the Financial Crisis*, Hoover Institution Press, Stanford, CA.
- Taylor, J.B. and Williams, J. (2009), “A Black Swan in the Money Market”, *American Economic Journal: Macroeconomics*, Vol. 1, No 1, pp. 58-83.
- Tinbergen, J. (1939), *Business Cycles in the United States of America: 1919-1932*, Statistical Testing of Business Cycle Theories, Vol. 2, League of Nations, Geneva.
- Tirole, J. and Farhi, E. (2009), “Collective Moral Hazard, Maturity Mismatch and Systemic Bailouts”, *NBER Working Paper Series*, No 15138.

Turner, P. (2010), “Central Banks and the Financial Crisis”, *BIS Papers*, No 51, Bank for International Settlements, Basel, pp. 21-25.

White, W.R. (2009), “Should Monetary Policy ‘Lean or Clean’?”, *Federal Reserve Bank of Dallas Working Paper*, No 34, August.

Woodford, M. (2003), *Interest and Prices: Foundations of a Theory of Monetary Policy*, Princeton University Press, Princeton.

Woodford, M. (2012) “Methods of Policy Accommodation at the Interest-Rate Lower Bound,” Columbia University manuscript, forthcoming in *The Changing Policy Landscape* (Kansas City: Federal Reserve Bank of Kansas City).

Wu, T. (2008), “On the Effectiveness of the Federal Reserve’s New Liquidity Facilities”, Federal Reserve Bank of Dallas, mimeo., May.