MONETARY POLICY STRATEGY: LESSONS FROM THE CRISIS[1]

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ABSTRACT

This paper examines what we have learned about monetary policy strategy and considers how we should change our thinking in this regard in the aftermath of the 2007-09 financial crisis. It starts with a discussion of where the science of monetary policy stood before the crisis and how central banks viewed monetary policy strategy. It then examines how the crisis has changed the thinking of both macro/monetary economists and central bankers. Finally, it looks at the extent to which the science of monetary policy needs to be altered and draws implications for monetary policy strategy.

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1 INTRODUCTION

Until August 2007, advances in monetary economics theory and in empirical work in the field had led both academic economists and policy-makers to argue that there was now a well-defined "science of monetary policy". There was a general consensus among central banks about most elements of monetary policy strategy, and monetary policy was perceived as being highly successful in OECD countries, with not only low inflation but also low variability of inflation. In addition, output volatility had declined in these countries, and the period from the early 1980s onwards was dubbed the "Great Moderation". Monetary economists and central bankers were feeling pretty good about themselves.

Then, in August 2007, the world was hit by what Alan Greenspan, former Chairman of the Federal Reserve System, described in Congressional testimony as a "once-in-a-century credit tsunami". The tsunami resulting from the 2007-09 financial crisis not only flattened economic activity, producing the most severe worldwide economic contraction since the Great Depression, but also seemed to sweep away confidence in the ability of central bankers to successfully manage the economy.

This paper examines what we have learned about monetary policy strategy and considers how we should change our thinking in this regard in the aftermath of the 2007-09 crisis. It starts with a discussion of where the science of monetary policy stood before the crisis and how central banks viewed monetary policy strategy. It then examines how the crisis has changed the thinking of both macro/monetary economists and central bankers. Finally, it looks at what implications this change in thinking has had for monetary policy science and strategy.

2 THE SCIENCE OF MONETARY POLICY BEFORE THE CRISIS

To examine the state of monetary policy analysis before the crisis I will draw heavily on a paper that I wrote just before the crisis began, which was presented at a conference at the Bundesbank in September 2007 (Mishkin (2009a)). In that paper I outlined nine basic scientific principles, derived from theory and empirical evidence, which guided thinking within almost all central banks. They are as follows: 1) inflation is always and everywhere a monetary phenomenon; 2)

price stability has important benefits; 3) there is no long-run tradeoff between unemployment and inflation; 4) expectations play a crucial role in the determination of inflation and in the transmission of monetary policy to the macroeconomy; 5) real interest rates need to rise with higher inflation, i.e. the Taylor Principle; 6) monetary policy is subject to the time-inconsistency problem; 7) central bank independence helps improve the efficiency of monetary policy; 8) commitment to a strong nominal anchor is central to producing good monetary policy outcomes; and 9) financial frictions play an important role in business cycles.

The first eight of these principles are elements of what has been dubbed the "new neoclassical synthesis" (Goodfriend and King (1997)), and before the crisis almost all academic economists and central bankers agreed with them. The last principle – that financial frictions play an important role in business cycles – was not explicitly a feature of models used for policy analysis in central banks, but it was well understood by many, although not all, central bankers. Because a key issue for this paper will be whether or not recent events overturn these principles, it is worth spending a fair amount of time understanding the theoretical and empirical basis for each of them.

Nine basic principles

1. Inflation is always and everywhere a monetary phenomenon.

By the 1950s and 1960s, the majority of macroeconomists had reached a consensus with regard to macroeconomic fluctuations that downplayed the role of monetary factors. Much of this consensus reflected the aftermath of the Great Depression and Keynes' seminal work *The General Theory of Employment, Interest, and Prices*, which identified shortfalls in aggregate demand as the source of the Great Depression and emphasised the role of fiscal factors as possible remedies. In contrast, in their research Milton Friedman and others, in what became known as the "monetarist" tradition (Friedman and Meiselman (1963); Friedman and Schwartz (1963a, 1963b)), attributed much of the economic malaise of the Depression to poor monetary policy decisions, and more generally argued that the growth in the money supply was a key determinant of aggregate economic activity and, particularly, inflation. Over time, this research, together with Friedman's predictions that expansionary monetary policy in the 1960s would lead

to high inflation and high interest rates (Friedman (1968)), had a major impact on the economics profession, with almost all economists eventually coming to agree with Friedman's famous adage that "inflation is always and everywhere a monetary phenomenon" (Friedman (1963)), provided that by inflation we mean a sustained increase in the price level (e.g. Mishkin (2010a)).[2]

This general agreement with Friedman's adage did not mean that all economists 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. In particular, an important manifestation of this line of thought was that central bankers came to recognise that keeping inflation under control was their responsibility.

2. Price stability has important benefits.

With the rise of inflation in the 1960s and 1970s, economists, and also the public and politicians, began to discuss the high costs of inflation (for example, see the surveys in Fischer (1993) and in Anderson and Gruen (1995)). High inflation undermines the role of money as a medium of exchange by acting as a tax on cash holdings. On top of this, a high-inflation environment leads to overinvestment in the financial sector, which expands to help individuals and businesses escape some of the costs of inflation (English (1996)). Inflation leads to uncertainty about relative prices and the future price level, making it harder for firms and individuals to make appropriate decisions, thereby decreasing economic efficiency (Lucas (1972); Briault (1995)). The interaction between the tax system and inflation also increases distortions that adversely affect economic activity (Feldstein (1997)). Unanticipated inflation causes redistributions of wealth, and, to the extent that high inflation tends to be associated with volatile inflation, these distortions can raise the costs of borrowing. Finally, some households undoubtedly do not fully

[2] Although inflation can be characterised as a monetary phenomenon, it is crucial to recognise that fiscal policy can drive monetary policy if there is fiscal dominance, that is, if government budget deficits get so large that they force monetary authorities to expand the money supply to pay for government spending. Monetary authorities are only able to keep inflation under control if governments pursue responsible fiscal policy so that fiscal dominance does not occur. The usual view is that fiscal dominance is rarely a feature of advanced countries and instead is limited to developing countries. However, the recent massive government budget deficits in advanced countries and the reluctance of politicians in these countries to rein in future entitlements may indicate that fiscal dominance is now a danger even for advanced economies.

understand the implications of a general trend in prices – that is, they may suffer from nominal illusion – making financial planning more difficult.[3] The total effect of these distortions came to be more fully appreciated over the course of the 1970s, and the recognition of the high costs of inflation led to the view that low and stable inflation can increase the level of resources productively employed in the economy.[4, 5]

3. There is no long-run tradeoff between unemployment and inflation.

A paper published in 1960 by Samuelson and Solow (1960) argued that research by Phillips (1958), which resulted in what became known as the Phillips curve, pointed towards a long-run tradeoff between unemployment and inflation and that this tradeoff should be exploited. Acting in accordance with this view, the policymaker would have to choose between two competing goals – inflation and unemployment – and decide how high an inflation rate he or she would be willing to accept to attain a lower unemployment rate. Indeed, Samuelson and Solow even mentioned that a non-perfectionist's goal of a 3% unemployment rate could be achieved alongside what they considered to be a not-too-high inflation rate of 4% to 5% per year. This thinking was influential, and probably contributed to monetary and fiscal policy activism aimed at bringing the economy to levels of employment that, with hindsight, were not sustainable. In fact, the economic record for the late 1960s and the 1970s was not a happy one: inflation accelerated, with the inflation rate in the United States and other industrialised countries eventually climbing above 10% in the 1970s, leading to what has been dubbed "The Great Inflation."

[3] Of course, economic theory implies that inflation can be either too high or too low. The discussion has emphasised costs associated with high inflation. But there are also potentially important costs associated with rates of inflation that are very low. For example, Akerlof, Dickens, and Perry (1996) suggest that downward nominal wage rigidity could result in severe difficulties for economic performance at times when inflation is too low. Other research has shown that the zero lower bound on nominal interest rates can lower economic efficiency if inflation is too low (e.g. Reifschneider and Williams (2000)). Eggertsson and Woodford (2003) discuss strategies to address the zero lower bound problem.

[4] A further possibility is that low inflation may even help increase the rate of economic growth. While time-series studies of individual countries and cross-national comparisons of growth rates were not in total agreement (Anderson and Gruen (1995)), the consensus grew that inflation is detrimental to economic growth, particularly when inflation rates are high.

[5] The deleterious effects of inflation on economic efficiency imply that the level of sustainable employment is probably lower at higher rates of inflation. Thus, the goals of price stability and a high employment rate are likely to be complementary, rather than competing, and so there is no policy tradeoff between the goals of price stability and maximum sustainable employment, the so-called dual mandate that the Federal Reserve has been given by Congress (Mishkin (2007a)).

The tradeoff suggested by Samuelson and Solow was hotly contested by Friedman (1968) and Phelps (1968), who independently argued that there was no long-run tradeoff between unemployment and the inflation rate: rather, the economy would gravitate to a natural rate of unemployment in the long run, no matter what the rate of inflation was. In other words, the long-run Phillips curve would be vertical, and attempts to lower unemployment below the natural rate would result only in higher inflation. The Friedman-Phelps natural rate hypothesis was immediately influential and fairly quickly began to be incorporated into formal econometric models.

Given the probable role that the attempt to exploit a long-run Phillips curve tradeoff had in the "Great Inflation", central bankers now adopted the natural rate, or no-long-run-tradeoff, view. Of course, my earlier discussion of the benefits of price stability suggests a long-run tradeoff, but not of the Phillips curve type. Rather, low inflation is likely to contribute to improved efficiency and hence higher employment in the long run.

4. Expectations play a crucial role in the macroeconomy.

A key assertion of the Friedman-Phelps natural rate hypothesis was that while sustained inflation may initially confuse firms and households, in the long run it does not boost employment because *expectations* of inflation adjust to any sustained rate of increase in prices. From the early 1970s onwards, the rational expectations revolution, which began with a series of papers by Lucas (1972, 1973, and 1976), took this reasoning a step further and demonstrated that the expectations of the public and the markets with regard to policy actions have important effects on almost every sector of the economy.[6] The theory of rational expectations assumed that economic agents are driven by optimising behaviour, and therefore their expectations of future variables are optimal forecasts (the best guess of the future), using all available information. The optimising behaviour posited by the theory of rational expectations indicates that expectations should respond immediately to new information, and the theory therefore suggests that the long

[6] The 1976 Lucas paper was already very influential in 1973, when it was first presented at the Carnegie-Rochester Conference. Note that although Muth (1961) introduced the idea of rational expectations more than ten years earlier, his work went largely unnoticed until resurrected by Lucas.

run might be quite short, so that attempting to lower unemployment below the natural rate could lead to higher inflation very quickly.

A fundamental insight of the rational expectations revolution is that expectations about future monetary policy have an important impact on the evolution of economic activity. As a result, the systematic component of policy-makers' actions – i.e., the component that can be anticipated – plays a crucial role in the conduct of monetary policy. Indeed, the management of expectations about future policy has become a central element of monetary theory, as emphasised in the recent synthesis by Woodford (2003).[7] And this insight has far-reaching implications, for example with regard to which types of systematic behaviour on the part of policy-makers are likely to be conducive to macroeconomic stability and growth.[8]

5. The Taylor Principle is necessary for price stability.

The recognition that economic outcomes depend on expectations of monetary policy suggests that policy evaluation requires a comparison of how the economy performs under different monetary policy rules.[9] One type of rule that has received enormous attention in economic literature is the Taylor rule (Taylor (1993)), which describes monetary policy as setting an overnight bank rate (federal funds rate in the United States) in response to the deviation of inflation from its desired level or target (the inflation gap) and the deviation of output from its natural rate level (the output gap).[10] Taylor emphasised that a rule of this type had desirable properties and that it would stabilise inflation only if the coefficient on the inflation gap exceeded unity. This conclusion came to be known as the "Taylor principle" (Woodford (2001))

[7] Indeed, one implication of rational expectations in a world of flexible wages and prices was the policy ineffectiveness proposition, which indicated that if monetary policy was anticipated, it would have no real effect on output; only unanticipated monetary policy could have a significant impact. Although evidence for the policy ineffectiveness proposition turned out to be weak (Barro (1977); Mishkin (1982a, 1982b, 1983)), the theory arising from the rational expectations revolution that monetary policy's impact on the economy is substantially influenced by whether it is anticipated or not has become widely accepted.

[8] Of course, the recognition that management of expectations is a central element in monetary policy-making brings to the forefront the credibility of monetary policy authorities as regards doing what they say they will do. It does not diminish, however, the importance of actions by the monetary authorities, because "actions speak louder than words": monetary authorities will be believed only if they take actions consistent with how they want expectations to be managed.

[9] Although Lucas' paper (1976) was a critique of the then-current practice of using econometric models to evaluate specific policy actions, it leads to the conclusion that monetary policy analysis should involve a comparison of how the economy performs under different rules.

[10] Variants of the Taylor rule also allow for interest rate smoothing, as in Taylor (1999).

and can be described most simply by saying that a stabilising monetary policy must raise the nominal interest rate by more than the rise in inflation. In other words, inflation will remain under control only if real interest rates rise in response to a rise in inflation. Although the Taylor principle now seems pretty obvious, estimates of Taylor rules, such as those by Clarida, Gali and Gertler (1998), indicate that during the late 1960s and 1970s many central banks, including the Federal Reserve, violated the Taylor principle, resulting in the "Great Inflation" that so many countries experienced during this period.[11] Indeed, as inflation rose in the United States, real interest rates fell.[12]

6. The time-inconsistency problem is relevant to monetary policy.

Another important development in the science of monetary policy that emanated from the rational expectations revolution was the discovery of the importance of the time-inconsistency problem in papers by Kydland and Prescott (1977), Calvo (1978), and Barro and Gordon (1983). The time-inconsistency problem can arise if monetary policy conducted on a discretionary, day-by-day basis leads to worse long-run outcomes than could be achieved by committing to a policy rule. In particular, policy-makers may find it tempting to exploit a short-run Phillips curve tradeoff between inflation and employment; but private agents, cognisant of this temptation, will adjust their expectations to anticipate the expansionary policy, so that it will result only in higher inflation with no short-run increase in employment. In other words, without a commitment mechanism, monetary policy-makers may find themselves unable to *consistently* follow an optimal plan *over time*; an optimal plan can be *time-inconsistent* and therefore could be soon abandoned. The notion of time-inconsistency has led to a number of important insights regarding central bank behaviour, such as the importance of reputation (formalised in the concept of *reputational equilibria*) and of institutional design.

7. Central bank independence improves macroeconomic performance.

The potential problem of time-inconsistency has led to a great deal of research into the importance of institutional features that can give central bankers the commitment mechanisms

[11] In contrast, Orphanides (2003) argues that the Federal Reserve did abide by the Taylor principle, but pursued overly expansionary policies during this period as a result of large and persistent misperceptions of the potential output level and the natural unemployment rate.

[12] E.g. the estimates in Mishkin (1981, 1992).

they need to pursue low inflation. Perhaps the most significant findings are those showing that central bank independence, at least in some respects, is likely to be very important in maintaining low inflation. Allowing central banks to be instrument-independent, i.e. allowing them to control the setting of monetary policy instruments, can help insulate them from short-run pressures to exploit the Phillips curve tradeoff between employment and inflation, and thus avoid the time-inconsistency problem.[13]

Evidence supports the conjecture that macroeconomic performance improves when central banks are more independent. When central banks in industrialised countries are ranked from least legally independent to most legally independent, the inflation performance is found to be the best for countries with the most independent central banks (Alesina and Summers (1993); Cukierman (1993); Fischer (1994); and the surveys in Forder (2000) and Cukierman (2006)).[14]

Although there is a strong case for instrument independence, the same is not true for goal independence, i.e. the ability of the central bank to set its own goals for monetary policy.[15] In a democracy, the public exercises control over government actions, and policy-makers are accountable – a situation that requires the goals of monetary policy to be set by the elected government. Although basic democratic principles dictate that the government should set the goals of monetary policy, the question of whether it should set goals for the short-run or intermediate-run is more controversial. For example, an arrangement in which the government

[13] For an example of how the time-inconsistency problem can be modeled as arising resulting from political pressure, see Mishkin and Westelius (2008). Instrument independence also insulates the central bank from the myopia that can be a feature of the political process. Instrument independence thus makes it more likely for the central bank to be forward-looking and to adequately allow for the long lags between monetary policy actions and inflation in setting their policy instruments.

[14] A case study constituting a striking example of the benefits of instrument independence is provided by the granting of instrument independence to the Bank of England in May 1997 (Mishkin and Posen (1997); Bernanke, Laubach, Mishkin and Posen (1999)); before that date, the Chancellor of the Exchequer (the finance minister) set the monetary policy instrument, not the Bank of England. During 1995 and 1996 the UK retail inflation rate (RPIX) was fairly close to 3%, but the spread between nominal and indexed bond yields – referred to as 10-year breakeven inflation – was substantially higher, in the range of 4% to 5%, reflecting investors' inflation expectations as well as compensation for perceived inflation risk at a 10-year horizon. Notably, breakeven inflation declined markedly on the day that the government announced the Bank of England's independence and has remained substantially lower ever since.

[15] The distinction between goal and instrument independence was first made by Debelle and Fischer (1994) and Fischer (1994).

sets a short-run inflation or exchange rate target that is changed every month or every quarter could easily lead to a serious time-inconsistency problem in which short-run objectives would dominate. In practice, however, this problem does not appear to be severe, because, for example, in many countries in which the government sets the annual inflation target, the target is rarely changed once price stability is achieved. Even though, in theory, governments could manipulate monetary policy goals to pursue short-run objectives, they usually do not if the goal-setting process is highly transparent.

However, the length of the lags between monetary policy and inflation is a technical issue that the central bank is well-placed to determine. Thus, for example, deciding how long it should take for inflation to return to a long-run goal necessarily requires judgement and expertise regarding the nature of the inflation process and its interaction with real activity. That need for judgement and expertise constitutes support for having the central bank set medium-term goals, because the speed with which it can achieve them depends on the lags of monetary policy. Whether the central bank or the government should set medium-term inflation targets is therefore an open question.

8. Credible commitment to a nominal anchor promotes price and output stability.

The inability of monetary policy to boost employment in the long run, the importance of expectations, the benefits of price stability, and the time-inconsistency problem are the reasons why a credible commitment to a nominal anchor – i.e. the stabilisation of a nominal variable such as the inflation rate, the money supply, or an exchange rate – is crucial to successful monetary policy outcomes.

An institutional commitment to price stability via the establishing of a nominal anchor provides a counterbalance to the time-inconsistency problem because it makes it clear that the central bank must focus on the long-run and thus resist the temptation to pursue short-run expansionary policies that are inconsistent with the nominal anchor. Commitment to a nominal anchor can also encourage governments to be more fiscally responsible, which also supports price stability. For example, persistent fiscal imbalances have, in the absence of a strong nominal anchor, led some governments, particularly in less-developed economies, to resort to the so-called inflation tax,

i.e. the issuing/printing of money to pay for goods and services, which leads to more inflation and is thus inconsistent with price stability.

Commitment to a nominal anchor also leads to policy actions that promote price stability, which helps promote economic efficiency and growth. A credible commitment to a nominal anchor helps stabilise inflation expectations, which reduces the likelihood of "inflation scares", in which expected inflation and interest rates shoot up (Goodfriend (1993)). Inflation scares lead to bad economic outcomes because the rise in inflation expectations leads not only to higher actual inflation but also to monetary policy tightening to get inflation back under control, which often results in large declines in economic activity. A credible commitment to a nominal anchor is therefore a crucial element in the successful management of expectations; and it is a key feature of the new neoclassical synthesis (Goodfriend and King (1997); Clarida, Gali and Gertler (1999); Woodford (2003)). A successful commitment to a nominal anchor has been found to produce not only more-stable inflation, but also lower volatility of output fluctuations (Fatás, Mihov and Rose (2007); Mishkin and Schmidt-Hebbel (2002, 2007)).

Commitment to a nominal anchor can also help stabilise output and employment. Specifically, to counter a contractionary demand shock, the monetary authorities' response may be to reduce the short-run nominal interest rate; however, the effectiveness of such a policy action may be hindered if long-run inflation expectations are not firmly anchored. For example, should the private sector become less certain about the longer-run inflation outlook, then an increase in the inflation risk premium could boost longer-term interest rates by more than the increase in expected inflation. A higher inflation risk premium would place upward pressure on the real costs of long-term financing for households and businesses (whose debt contracts are almost always expressed in nominal terms) and hence could partially offset the direct monetary stimulus. Thus, a central bank commitment that firmly anchors long-run inflation expectations can make an important contribution to the effectiveness of the central bank's actions aimed at stabilising economic activity in the face of adverse demand shocks.

9. Financial frictions play an important role in the business cycle.

Research outlining how asymmetric information could impede the efficient functioning of the financial system (Akerlof (1970); Myers and Majluf (1984); Greenwald, Stiglitz and Weiss (1984)) suggests an important link between business cycle fluctuations and financial frictions. When shocks to the financial system increase information asymmetry and thereby dramatically increase financial frictions, it gives rise to financial instability, and to the financial system no longer being able to channel funds to those with productive investment opportunities. This can result in the economy experiencing a severe economic downturn (Mishkin (1997)). The rediscovery years later of Fisher's paper on the Great Depression (1933) led to the recognition that financial instability played a central role in the collapse of economic activity during that period (Mishkin (1978); Bernanke (1983); and the survey in Calomiris (1993)), and it spawned a large amount of literature on the role of financial frictions in business cycle fluctuations (e.g. Bernanke and Gertler (1999, 2001); Bernanke, Gertler and Gilchrist (1999); Kashyap and Stein (1994)). Empirical evidence also strongly supported the proposition that the most severe business cycle downturns are always associated with financial instability, not only in advanced countries but also in emerging market countries (Mishkin (1991, 1996)).

Even before the crisis, most central bankers understood that financial disruptions could be very damaging to the economy, and this explains the extraordinary actions that central banks took during the crisis to shore up financial markets (Mishkin (2011)). However, the macroeconomic models used for forecasting and policy analysis, whether they were dynamic stochastic general equilibrium (DSGE) models or more traditional macroeconometric models such as FRBUS, which is used at the Federal Reserve, did not allow for the impact of financial frictions and disruptions on economic activity.

2.1 THEORY OF OPTIMAL MONETARY POLICY

The theory of optimal monetary policy starts by specifying an objective function that represents economic welfare, that is, the well-being of households in the economy, and then maximises this objective function, subject to constraints provided by a model of the economy. Before the crisis, both the objective function and the model of the economy were based on the principles of the new neoclassical synthesis.

2.1.1 OBJECTIVE FUNCTION

Standard descriptions of the central bank's objective function have been expressed in terms of two components (e.g. Svensson (1997); Clarida, Gali and Gertler (1999); Woodford (2003)). The benefits of price stability (principle 2) are reflected in the first component, which involves minimising the deviations of inflation from its optimal rate, which most central bankers take to be around the 2% level. The second component reflects the costs of underutilised resources in the economy and involves minimising the deviations of real economic activity from its natural rate level, which is the efficient level determined by the productive potential of the economy. Because expectations about the future play a central role in the determination of inflation and in the transmission mechanism of monetary policy (principle 4), in order to achieve an optimal monetary policy the intertemporal nature of economic welfare must be taken into account, and the objectives both for the present state of the economy and for the expected path in future periods maximised. Given that inflation is a monetary phenomenon and is thus viewed as controllable by monetary policy (principle 1), the central bank sets its policy instruments (under normal circumstances, a short-term interest rate) to maximise the objective function, subject to the constraints.

2.1.2 CONSTRAINTS: THE MODEL

The constraints, as embodied in macroeconometric models in use at central banks before the crisis, also reflect the principles of the new neoclassical synthesis. These models display no long-run tradeoff between unemployment and inflation (principle 3). Expectations play a central role in household and business behaviour (principle 4) and lead to the existence of the time-inconsistency problem (principle 5). The models also display the importance of a credible commitment to a strong nominal anchor in order to produce good monetary policy outcomes (principle 8), and this requires an independent central bank (principle 7). Because the transmission of monetary policy to the economy operates through the real interest rate, real interest rates have to rise in order to stabilise inflation (Taylor principle 5).

2.1.3 LINEAR-QUADRATIC FRAMEWORK

As we have seen, the objective function and the model (constraints) used by central banks before the crisis reflected all eight principles of the new neoclassical synthesis. However, the approach to analysing optimal monetary policy used by central banks had an additional important feature: it made use of a linear-quadratic (LQ) framework, in which the equations describing the dynamic behaviour of the economy are *linear* – a basic feature of DSGE models – and the objective function specifying the goals of policy is *quadratic*. For example, the objective function was characterised as a loss function comprising the squared value of the inflation gap (that is, actual inflation minus desired inflation) and the squared value of the output gap (that is, actual output minus potential output).

2.1.4 REPRESENTATIVE-AGENT FRAMEWORK

The models also contained another additional feature: a representative-agent framework in which all agents are alike, thereby precluding the presence of financial frictions as the latter require agents to differ, particularly in the amount of information they have. With asymmetric information ruled out, the financial sector has no special role to play in economic fluctuations. Thus, although central bankers were aware of principle 9, i.e. that financial frictions could have an important effect on economic activity, financial frictions were not a key feature in the macroeconometric models used in central banks and were not an element of the pre-crisis theory of optimal monetary policy.

3 MONETARY POLICY STRATEGY BEFORE THE CRISIS

The science of monetary policy described above had several implications for monetary policy strategy, some of which were generally agreed to by almost all central bankers and others of which were accepted by most, but not all, central bankers, but on which there was not a complete consensus.

3.1 FLEXIBLE INFLATION TARGETING

The monetary policy strategy that follows from the eight principles of the new neoclassical synthesis is referred to in the academic literature as “flexible inflation targeting” (Svensson (1997)). It involves a strong, credible commitment by the central bank to stabilising inflation in the long run, often at an explicit numerical level, but also allows for the central bank to pursue policies aimed at stabilising output around its natural rate level in the short run.
The phrase “inflation targeting” to describe this monetary policy strategy is somewhat unfortunate. Although I would argue that almost all central banks that have an independent monetary policy follow the general principles of flexible inflation targeting, they do have very different approaches to the communication strategy surrounding it. Some central banks announce an explicit numerical inflation objective and treat it as a target – these are classified as fully fledged inflation targeters – while others are reluctant to be so explicit.

For example, the Federal Reserve has espoused a strong commitment to stabilising inflation, but has not been willing to announce an explicit inflation objective. Instead, the Federal Reserve reports on the individual Federal Open Market Committee (FOMC) participants’ projections of inflation in the long run under “an appropriate monetary policy”. In effect, the Federal Reserve provides the long-run inflation objective for each FOMC participant, but has not required that the participants agree on a common objective for inflation. The Federal Reserve has therefore not yet adopted an agreed-upon inflation objective and so it is not classified as being in the inflation-targeting camp. On the other hand, the FOMC participants’ long-run inflation projections have all fallen within a pretty tight range – between 1 ½ and 2% – and so they are not far from committing to a specific inflation objective: it would not require a vast degree of modification to their communication strategy to move them to the inflation targeting camp (Mishkin (2008)).

In other cases, such as those of the European Central Bank and the Swiss National Bank, central banks have been willing to announce an explicit numerical inflation objective, but are reluctant to treat it as a target because they believe that this would not give them sufficient flexibility. They are unwilling to be classified as inflation targeters because they believe that the use of the

word “target” might lead the public to expect them to hit the inflation targets too precisely or over too specific a horizon.

Despite these apparent differences in communication strategy, the basic approach of central banks with an independent monetary policy before the crisis was very similar. They adhered to the eight principles of the new neoclassical synthesis and were willing to conduct monetary policy under a strong commitment to stabilising inflation in the long run. Indeed, Svensson (2002) argues that any central bank that indicates that it will pursue the standard objective function, involving minimising both inflation and output gap in an intertemporal setting, is effectively a flexible inflation targeter. Before the crisis, almost all central banks with an independent monetary policy fell into this classification.

3.2 CERTAINTY EQUIVALENCE, GRADUALISM AND RISK MANAGEMENT

Under the assumptions of the linear-quadratic framework, the optimal policy is 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.[16]

Indeed, 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, ¼ or ½ percentage point) and sharp reversals in the funds rate path were rare. Numerous empirical studies have characterised monetary policy before the crisis using Taylor-style rules, in which

[16] 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).

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.[17]

Although in many ways central banks have conducted monetary policy under a certainty equivalence strategy, central bankers have not been completely comfortable with this approach to monetary policy. While a linear-quadratic framework may provide a reasonable approximation of how optimal monetary policy operates under fairly normal circumstances, this approach is less likely to be adequate for the consideration of monetary policy when there is a risk, however small, of particularly poor economic performance. First, the dynamic behaviour of the economy may well exhibit nonlinearities, at least in response to some shocks (Hamilton (1989); Kim and Nelson (1999); Kim, Morley and Piger (2005)). Furthermore, the use of a quadratic objective function does not reflect the extent to which most individuals have a strong preference for minimising the incidence of worst-case scenarios. Therefore, given the central bank's ultimate goal of maximising public welfare, there is a case to be made for monetary policy to reflect the public's preference of avoiding particularly adverse economic outcomes.

Their discomfort with a certainty equivalence approach to monetary policy led central bankers to exposit a "risk management" approach to the conduct of monetary policy, even before the crisis. Alan Greenspan indeed described his thinking about monetary policy as exactly such an approach (Greenspan (2003)), although he was not very explicit about what this meant. However, it is clear that even before the crisis, central bankers were aware that they had to worry about risks of very bad economic outcomes. Specifically, they were aware that in some circumstances the shocks hitting the economy might exhibit excess kurtosis, commonly referred to as "tail risk", in which the probability of relatively large disturbances is higher than would be implied by a Gaussian distribution.

3.3 DICHOTOMY BETWEEN MONETARY POLICY AND FINANCIAL STABILITY POLICY

[17] 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).

Even before the crisis, central bankers were aware that financial disruptions could have a serious negative impact on the economy. This is why many central banks not only issued reports on monetary policy, but also published *Financial Stability Reports* to discuss potential threats to the financial system. Nonetheless, the general equilibrium modelling frameworks at central banks did not incorporate financial frictions as a major source of business cycle fluctuations. This naturally led to a dichotomy between monetary policy and financial stability policy in which these two types of policies were conducted separately. Monetary policy instruments would focus on minimising inflation and output gaps. It would then be up to prudential regulation and supervision to prevent excessive risk-taking that could promote financial instability.

Although I would say that most central bankers supported the dichotomy between monetary policy and financial stability policy, there were views that monetary policy should address financial stability issues, particularly as regards responding to potential asset price bubbles, as discussed below.

3.4 RESPONSE OF MONETARY POLICY TO ASSET PRICE BUBBLES: THE "LEAN" VERSUS "CLEAN" DEBATE

One active debate in central banks before the crisis focused on how central banks should respond to potential asset price bubbles. Because asset prices are a central element in the transmission mechanisms of monetary policy, the theory of optimal monetary policy requires that monetary policy responds to asset prices in order to obtain good outcomes in terms of inflation and output. Hence, the issue of how monetary policy might respond to asset price movements is not whether it should respond at all, but whether it should respond at a level over and above that called for in terms of the objectives of stabilising inflation and employment. Another way of defining the issue is whether monetary policy should try to pop, or slow, the growth of possibly-developing asset price bubbles in order to minimise damage to the economy when these bubbles burst. Alternatively, rather than responding directly to possible asset price bubbles, should the monetary authorities respond to asset price declines only after a bubble bursts, to stabilise both output and inflation? These opposing positions have been characterised as *leaning* against asset

price bubbles versus *cleaning up* after the bubble bursts, and so the debate over what to do about asset price bubbles has been labelled the "lean versus clean" debate.

Even before the crisis, there was no question that asset price bubbles have negative effects on the economy. As Dupor (2005) emphasised, the departure of asset prices from fundamentals can lead to inappropriate investments that decrease the efficiency of the economy. Furthermore, throughout history the bursting of bubbles has been followed by sharp declines in economic activity, as Kindleberger's (1978) famous book demonstrated.

Before the crisis, the clear-cut dangers of asset price bubbles led some economists – both inside and outside central banks, for example Cecchetti and others (2000), Borio and Lowe (2002), Borio, English and Filardo (2003), and White (2004) – to argue that central banks should at times "lean against the wind" by raising interest rates to stop bubbles from getting out of hand. They argued that raising interest rates to slow a bubble's growth would produce better outcomes because it would either prevent the bubble or would result in a less severe bursting of the bubble, with far less damage to the economy.

The opposing view to the "leaning against the wind" view that asset prices should have a special role in the conduct of monetary policy, over and above that implied by their foreseeable effect on inflation and employment, is often referred to as the "Greenspan doctrine", because, when Chairman of the Federal Reserve Board, he strenuously argued that monetary policy should not try to lean against asset price bubbles, but rather should just clean up after they burst (Greenspan (2002)).[18] There were several elements to this argument.

First, bubbles are hard to detect. In order to justify leaning against a bubble, a central bank must assume that it can identify a bubble in progress. That assumption was viewed as highly dubious because it is hard to believe that the central bank has such an informational advantage over private markets. If the central bank has no informational advantage, and if it knows that a bubble has developed, the market will almost surely know this too, and the bubble will burst. Thus, any

[18] I was also a proponent of this view (Mishkin (2001a, 2007b)).

bubble that can be identified with certainty by the central bank would be unlikely ever to develop much further.

A second objection to leaning against bubbles was that raising interest rates may be very ineffective in restraining the bubble, given that market participants expect such high rates of return from buying bubble-driven assets.[19]

A third objection was that there are many asset prices, and at any one time a bubble may be present in only a fraction of assets. Monetary policy actions are a very blunt instrument in such a case, as such actions are likely to affect asset prices in general, rather than solely those in a bubble.

Fourth, although some theoretical models suggested that raising interest rates could diminish the acceleration of asset prices, others suggested that raising interest rates could cause a bubble to burst more severely, thus doing even more damage to the economy (Bernanke, Gertler and Gilchrist (1999); Greenspan (2002); Gruen, Plumb and Stone (2005); Kohn (2006)). This view was supported by historical examples, such as the monetary tightening that occurred in 1928 and 1929 in the United States and in 1989 in Japan, suggesting that raising interest rates may cause a bubble to burst more severely, thereby increasing the damage to the economy.[20] Another way of saying this is that bubbles are departures from normal behaviour, and it is unrealistic to expect that the usual tools of monetary policy will be effective in abnormal conditions. Attempts to prick bubbles were thus viewed as possibly violating the Hippocratic oath of "do no harm".

Finally, there was a view that the monetary authorities have the tools to keep the harmful effects of a bursting bubble at a manageable level, as long as they respond in a timely fashion. This was held to be true even in the event of interest rates falling and approaching the zero lower bound, and so the conventional tool of lowering the policy interest rate would no longer an option. The economy could be stimulated by 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)

[19] For example, see the discussion in Greenspan (2002).
[20] For example, see Gruen, Plumb and Stone (2005), Hamilton (1987), Cargill, Hutchison and Ito (1995), Jinushi, Kuroki and Miyao (2000) and Posen (2003).

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.[21]

One counterargument to this view was the disastrous experience of Japan after the bursting of the stock market and real estate bubbles. However, as Posen (2003) pointed out, the problem in Japan was not so much the bursting of the bubble as the subsequent policies. The imbalances in Japan's banking sector were not resolved, so they continued to get worse well after the bubble had burst. In addition, as pointed out in Ahearne and others (2002), the Bank of Japan did not ease monetary policy sufficiently or rapidly enough in the aftermath of the crisis.

The bottom line of the analysis behind the Greenspan doctrine was that the cost of leaning against asset price bubbles was likely to be high, while the cost of bursting bubbles could be kept low. Rather than advocating leaning against bubbles, the view supported an approach in which central banks just clean up after the bubble. This approach was fully consistent with monetary policy focusing on stabilising inflation and employment without a special focus on asset price bubbles.

Another argument against focusing on asset prices is that it could lead to public confusion regarding the objectives of such a policy. As reported in Giavazzi and Mishkin (2006), interviews with participants from different sectors of Swedish society suggested that statements on house prices by Sveriges Riksbank confused the public and led to a general weakening of confidence in the Swedish central bank.

I would argue that the Greenspan doctrine, which was strongly supported by Federal Reserve officials, held great sway in the central banking world before the crisis. However, there were dissenting voices. For example, over the course of several meetings in 2004, a minority of members of the Monetary Policy Committee (MPC) of the Bank of England argued in favour of raising interest rates more than could be justified in terms of the Bank's objectives for inflation

[21] E.g. see Svensson (2001), and Bernanke (2004).

over its normal policy horizon.[22] According to the minutes of those meetings, the advocates believed that such a move would reduce the risk of high house-price appreciation and the rapid accumulation of household debt leading to an abrupt adjustment process, with serious negative consequences for the economy.[23] Mervyn King, the Governor of the Bank of England, did not advocate leaning against the wind, but did suggest that to prevent a build-up of financial imbalances a central bank might extend the horizon over which inflation is brought back to target (King (2004a, 2004b)). Statements from officials at the European Central Bank and other central banks also suggested that in the event of an asset boom or bust, a longer period than the usual one to two years might be required to assess whether the price stability goal was being met (Issing (2003a, 2003b); Stevens (2004); Selody and Wilkins (2004); Bank of Canada (2006); Rosenberg (2006)).

4 HOW HAS THE CRISIS CHANGED OUR THINKING?

The global financial crisis of 2007-09 was not only a tsunami that flattened the economy: in the eyes of some commentators it flattened the science of monetary policy, necessitating a total rethink. Armed with an understanding of where the science of monetary policy stood before the crisis, we can now consider which aspects of the events that unfolded during the crisis require us to modify our earlier analysis. From my reading of the crisis, there are five lessons that should change how we think about the science of monetary policy and monetary policy strategy.

1. Developments in the financial sector have a far greater impact on economic activity than we previously realised.

Although central bankers generally recognised that financial frictions could play an important role in business cycle fluctuations, the 2007-09 financial crisis made it clear that the adverse effects of financial disruptions on economic activity could be far worse than originally anticipated for advanced economies. When the financial crisis started in August 2007, central bank actions to contain it seemed to be working. Many central bank officials, although still concerned about the disruption to the financial markets, hoped that the worst was over and that

[22] Bank of England (2004), MPC Minutes: January, p. 8; March, p. 9; April, p. 9; and August, p. 9.
[23] Bank of England (2004), MPC Minutes, March, p. 8.

the financial system would begin to recover (see Mishkin (2011)). The subprime mortgage sector was after all only a small part of the overall capital market, and the losses in the subprime mortgage market, although substantial, still seemed manageable. By the summer of 2008, central banks were even turning their attention to the very high inflation rates at the time: for example, there were discussions within the Federal Reserve as to whether the easing phase of monetary policy might have to be reversed in order to contain inflation (e.g. see Wessel (2009))

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But then came a set of shocks that sent the financial system and the economy over the cliff: the Lehman Brothers bankruptcy on 15 September 2008, the AIG collapse on 16 September, the run on the Reserve Primary Fund on the same day, and the US Treasury's struggle to get the TARP plan approved by US Congress over the following couple of weeks (Mishkin (2011)). The financial crisis now morphed into a global crisis, causing a sharp drop in economic activity in the United States – real GDP declined 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. The unemployment rate shot up to over 10% in the United States and in many other advanced economies, and it remained stubbornly high even after the world economy started to recover. The worldwide recession that resulted from the financial crisis turned out to be the most severe economic contraction since the worldwide depression of the 1930s.

The global financial crisis of 2007-09 therefore demonstrated that financial frictions should be front and centre in macroeconomic analysis: they could no longer be ignored in the macroeconometric models that central banks used for forecasting and policy analysis, as we saw was the case before the crisis. As a result of this, there has been a resurgence of interest in the interaction of finance and macroeconomics. Economists, both in academia and in central banks, are now actively trying to build financial frictions into their general equilibrium models, and there is a new body of literature, currently in its infancy, based on the exploration of how financial frictions would modify the prescriptions provided by the science of monetary policy.[24]

2. The macroeconomy is highly nonlinear.

[24] For example, see Gertler and Karadi (2009) and Curdia and Woodford (2009).

Because economic downturns typically result in even greater uncertainty about asset values, such episodes may involve an adverse feedback loop whereby financial disruptions cause investment and consumer spending to decline, which, in turn, causes economic activity to contract. Such contraction then increases uncertainty about the value of assets, and, as a result, the financial disruption worsens. In turn, this development causes economic activity to contract further, in a perverse cycle.

The deterioration of balance sheets during a recession can also intensify problems of adverse selection and moral hazard because it removes an important channel through which information asymmetries can be mitigated: the use of collateral. 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 macroeconomic downturns, the value of collateral may fall, problems of adverse selection and moral hazard again become central, and lenders become much less willing to lend. Again, these events can result in an adverse feedback loop.

The events following the Lehman Brothers bankruptcy showed how nonlinear both the financial system and the macroeconomy could be. In the aftermath, 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 subsequent economic downturn, which saw the collapse of real GDP and world trade during the fourth quarter of 2008 and the first half of 2009, as mentioned above, also indicated that the macroeconomy can at times be highly nonlinear.

The role of nonlinearities in the macroeconomy when there is a financial disruption implies an important flaw in the theory of optimal monetary policy that was in general use prior to the crisis: the theory of optimal monetary policy was based on the assumption that the macroeconomy can be described by linear dynamic equations. The financial crisis of 2007-09

demonstrated that although the linear-quadratic framework may provide a reasonable approximation of how optimal monetary policy operates under fairly normal circumstances, this approach is not adequate for the consideration of monetary policy when financial disruptions hit the economy.[25] Furthermore, the use of a quadratic objective function does not reflect the extent to which most individuals have a strong preference for minimising the incidence of worst-case scenarios, such as the one we have just experienced. Therefore, given that the central bank's ultimate goal is the maximisation of public welfare, the design of monetary policy should reflect the public's preferences, especially with respect to avoiding particularly adverse economic outcomes.

Most of the quantitative studies of optimal monetary policy have also assumed that shocks hitting the economy have a time-invariant Gaussian distribution, that is, a classical bell curve with symmetric and well-behaved tails. In reality, however, the distribution of shocks hitting the economy is more complex. In some instances, the uncertainty facing the economy is clearly skewed in one direction or another; again, this is likely when there are significant financial disruptions. In addition, as we have seen with the recent crisis, shocks hitting the economy may exhibit excess kurtosis, that is, tail risk, because the probability of relatively large negative disturbances is higher than would be implied by a Gaussian distribution.

3. The zero lower bound is more problematic than we realised.

As discussed earlier, before the crisis, central bankers recognised that the zero lower bound for nominal interest rates would require the use of non-conventional monetary policy in the event of a contractionary shock causing interest rates to fall toward zero. One view is that the zero lower bound problem is more serious than originally contemplated because non-conventional monetary policy was not that effective during the crisis. I disagree strongly with this view.

The shock to the financial system resulting from the global financial crisis was in many ways more complicated than the shock that produced the Great Depression of the 1930s, and yet the economic contraction turned out to be far less severe. One key factor that appreciably lessened

[25] Even before the crisis there was some research which recognised that the dynamic behaviour of the economy could exhibit nonlinearities, at least in response to some shocks (Hamilton (1989); Kim and Nelson (1999); Kim, Morley and Piger (2005)).

the severity of the recent economic downturn was that monetary policy was very aggressive, and that it was effective.[26]

Non-conventional monetary policy took four forms: 1) liquidity provision in which central banks expanded 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 expanded their balance sheets; and 4) management of expectations, which involved central banks committing to keeping their policy rate at very low levels for a long period of time.

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.

Research on the impact of the Federal Reserve's large-scale asset purchases during the global financial crisis by Gagnon, Raskin, Remache and Sack (2010) finds that these programmes lowered long-term bond rates relative to short rates by around 50 basis points, and lowered

[26] Not all economists would agree with this view, notably John Taylor (2009).

mortgage-backed securities (MBS) interest rates even further by improving liquidity in this market, thereby having a substantial impact on residential mortgage rates.

I am more sceptical of quantitative easing, by itself, making much difference to stimulating the economy. Why should an expansion of the monetary base lead to higher aggregate demand when it was unable to lower interest rates further or stimulate bank lending? (For example, see Curdia and Woodford (2009)). In addition, evidence from the Japanese episode does not provide much support for the theory that a pure expansion of a central bank's balance sheet can be effective in stimulating aggregate demand (Kuttner (2004)).

There is strong theoretical support for the idea that the management of expectations stimulates spending when the policy rate hits the zero lower bound, because a commitment to keep short-term interest rates low for a substantial period of time helps lower long-term interest rates and also raises inflation expectations, thereby reducing the real interest rate (Eggertsson and Woodford (2003, 2004) and Woodford (2003)). However, empirical evidence on how effective management of expectations was during this episode is not yet available.

What I take from all this evidence is that non-conventional monetary policy was effective during the recent financial crisis. I would also argue that conventional monetary policy was effective as well – even more so during this financial crisis than is normally the case (Mishkin (2009b)). To see this, we can think about the counterfactual: what would have happened to the interest rates relevant to spending decisions by households and businesses if the Federal Reserve had *not* lowered the federal funds rate by over 500 basis points starting in September 2007? Clearly interest rates on default-free Treasury securities would have been higher, but also credit spreads would have widened by even more than they did during the crisis, because the weaker economy would have made conditions in financial markets even more stressed. Another way of saying this is that macroeconomic risk would have been higher, and so credit spreads would have been higher, along with higher default-free interest rates. The outcome would then surely have been that households and firms would have faced much higher interest rates, with the result that household and firm spending would have declined even more precipitously, leading to a far deeper recession and possibly even a depression. The problem with regard to conventional

monetary policy during the financial crisis is not that it was ineffective, but that the contractionary shock from the financial crisis was so severe that it overwhelmed the ability of conventional monetary policy to counteract it.

My view that monetary policy, both conventional and non-conventional, was effective during the crisis does not imply that the zero lower bound problem is less serious. Indeed, the lesson that I take from the crisis is that it is a more serious problem than central bankers anticipated. Research before the crisis took the view that as long as the inflation objective was around 2%, then the zero lower bound problem would not be very serious because it would be infrequent and short-lived (Reifschneider and Williams (2000) and Coenen, Orphanides and Wieland (2004)). The fact that the Federal Reserve has had to resort to non-conventional monetary policy twice during the first decade of the 21st century – once in 2003-04 when it made a commitment to keep interest rates low for a considerable period, and once during the 2009-10 period – suggests that the zero lower bound problem may be far more prevalent than earlier research suggested, and not 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 to the economy can be far greater than previously anticipated. Again, this results from the presence of nonlinearities and large tail risks. Sufficiently large contractionary shocks can make the costs of the zero lower bound constraint very significant. Large contractionary shocks can thus overwhelm the ability of conventional policy to counteract them, and may necessitate massive interventions in credit markets and the expansion of central bank balance sheets. As I will discuss below, these massive interventions may have a very high cost for central banks later on.

4. The cost of cleaning up after financial crises is very high.

Besides the obvious cost of a huge loss of aggregate output as a result of the worldwide recession, the global financial crisis suggests that there are likely to be three additional costs that will raise the total cost far higher: 1) financial crises are typically followed by very slow growth;

2) the budgetary position of governments may sharply deteriorate; and 3) the exit strategy for central banks from non-conventional monetary policy may both be complicated and hinder the ability of the central bank to successfully manage the economy in the future.

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 current crisis looks like it will be no exception.

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. Furthermore, this rise in indebtedness has the potential to lead to sovereign debt defaults, which has become a serious concern in Europe following the Greek sovereign debt crisis and the problems that the Irish government is facing as a result of the spiralling cost of bailing out their banking system. The fiscal retrenchments required to put fiscal balances on a sustainable path are

likely to not only be contractionary, but also to increase societal stress. Indeed, there is even a possibility that the fiscal problems brought on by the crisis could lead to countries exiting from the euro.

Actions by central banks aimed at containing the global financial crisis resulted in huge expansions of their balance sheets. The expansion of balance sheets arising from liquidity provision is typically easy to reverse because most liquidity facilities provide loans at interest rates that are higher than market rates during normal times. Hence these liquidity facilities are self-liquidating because as financial markets return to normal, market participants are no longer willing to borrow at above-market rates, so the use of these facilities shrinks. Hence this source of balance sheet expansion naturally reverses itself as the financial system recovers, and this is exactly what has happened.

A far more serious concern is the expansion of the balance sheet that stems from asset market purchases. This expansion of the balance sheet is not self-liquidating and there are concerns that the resulting expansion of the monetary base will lead to high inflation in the future. This would be of greater concern if the expansion in the monetary base was closely linked to inflation, but this is unlikely to be the case in the current environment. The huge increase in the monetary base of 144.6% in the United States from August 2007 to the end of 2009 has resulted in only a 16.0% increase in M2, because banks are perfectly happy to hold onto to huge amounts of excess reserves as long as they are paid interest on them, as is the case currently. Indeed, as argued earlier, because quantitative easing was unlikely to have had a large expansionary effect during the financial crisis, the large increase in the monetary base is unlikely to be inflationary.

More problematic is the fact that asset market purchases were often for long-term securities, and 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. [27]

Even the purchase of long-term government securities poses 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 not only by governments that have large fiscal imbalances, but also even by a government – in the case of Greece – that lied about its fiscal position. 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.[28]

5. 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

[27] A particular problem for the Federal Reserve is that its holdings of MBSs on its balance sheet directly involve it in the most politicised 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.

[28] See Cochrane (2010) for a discussion of how recent fiscal events could lead to a rise in inflation expectations.

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.

5 HOW MUCH OF THE SCIENCE OF MONETARY POLICY NEEDS TO BE ALTERED?

Pundits, such as Paul Krugman (2009) and the Economist Magazine (2009), have argued that the financial crisis has revealed deep flaws in the modern field of macro/monetary economics developed over the last forty or so years and that this field needs to be completely overhauled.[29] Indeed, Krugman titled his 2009 New York Times Magazine article "How Did Economists Get It So Wrong?". Does this mean that the science of monetary policy as we knew it before the crisis should be abandoned, and that policy-makers and monetary economists should start all over, as Krugman seems to imply?

To answer this question, let's examine which elements of the science of monetary policy are repudiated by the lessons from the financial crisis that we discussed in the previous section. First, let's look at the basic principles of the science of monetary policy, and then the theory of optimal monetary policy.

5.1 BASIC PRINCIPLES OF THE SCIENCE OF MONETARY POLICY

The lessons from the crisis are as follows: that the financial sector can have a very large impact on economic activity and can make the economy highly nonlinear; that the zero lower bound problem can be very serious, which is just one of the reasons why cleaning up after financial crises can have very high costs; and that price and output stability do not ensure financial

[29] See Lucas (2009) and Cochrane (2009) for spirited replies to both the Economist (2009) and Krugman (2009) articles.

stability. One reason why I devoted so much time earlier in the paper to the theory and empirical work that supports the nine principles of the science of monetary policy is that we can now ask whether any of the lessons from the crisis refute the justification for those principles. Upon examination of the reasoning behind each of the nine principles discussed earlier, the answer is very clear-cut: ***none of the lessons from the financial crisis in any way undermine or invalidate the nine basic principles of the science of monetary policy developed before the crisis.***

Each of the five lessons from the crisis is completely orthogonal to the theory or empirical work that supports the eight principles of the new neoclassical synthesis. The lessons in no way weaken the case for any of these principles. The above conclusion is an extremely important one (and this is why I boldfaced and italicised it to make it stand out). It tells us that we should not throw out all that we have learned in the field of macro/monetary economics over the last forty years, as some pundits seem to suggest. Rather, much of the edifice of the science of monetary policy is clearly still as valid today as it was before the crisis. As we shall see, this has important implications for how we view monetary policy strategy.

The lesson that developments in the financial sector can have a large impact on economic activity indicates not only that the ninth principle about financial frictions is of course valid, but also that it is now even more important than central bankers previously realised.

5.2 THEORY OF OPTIMAL MONETARY POLICY

On the other hand, the lessons from the crisis do undermine two key elements of the pre-crisis theory of optimal monetary policy. The lesson that the macroeconomy is inherently nonlinear undermines the linear-quadratic framework that is a key element of that policy. The lesson that the developments in the financial sector can have a major impact on economic activity undermines the representative-agent framework, another key element of the pre-crisis theory of optimal monetary policy. Doubts about the linear-quadratic and representative-agent frameworks that have arisen because of the financial crisis also have important implications for the strategy of monetary policy.

6 IMPLICATIONS FOR MONETARY POLICY STRATEGY

Armed with an understanding of which areas of the science of monetary policy need rethinking, we can examine how monetary policy strategy might be modified in each of the four areas of monetary policy strategy we discussed earlier.

6.1 FLEXIBLE INFLATION TARGETING

I have referred to the monetary policy strategy that follows from the eight principles of the new neoclassical synthesis as flexible inflation targeting, for want of a better name. Since, as I have argued here, none of the principles are invalidated by the events of the recent financial crisis, this approach to monetary policy strategy is still equally valid. The arguments supporting central bank adherence to the principles of the new neoclassical synthesis are still every bit as strong as they were before the crisis. Therefore, there is still strong support for central banks having 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.

Although the support for the flexible inflation targeting framework is not weakened by the lessons from the financial crisis, the lessons do suggest that the details of how flexible inflation targeting is conducted, and of what is meant by flexibility, need to be rethought. Let us first look at two possible basic modifications to the flexible inflation targeting framework: the choice of the level of the inflation target, and whether some form of price level targeting would produce better economic outcomes.

6.1.1 LEVEL OF THE INFLATION TARGET

Because the financial crisis has shown that the zero lower bound problem could be more serious than previously thought, there is the question of whether the optimal inflation rate level for a central bank target should be higher than the typical value of around 2%. With a higher inflation

target, the real interest rate can be driven down to lower levels in the face of adverse aggregate demand shocks. For example, Blanchard, Dell'Ariccia and Mauro (2010) have suggested that the inflation target might be raised from the 2% to the 4% level. With expectations of inflation anchored to this target, by lowering the nominal interest rate to zero the real interest rate could be lowered to as low as -4%, rather than -2% with the 2% inflation target. Conventional monetary policy, which involves manipulating the nominal policy rate, would then be able to ease monetary policy to a greater extent than it could with the lower inflation target. Another way of stating this is to say that the zero lower bound on the policy rate would be less binding with a higher inflation target.

This argument suggests that inflation targets of less than 2% might be undesirable. While some FOMC participants have declared their desired long-run inflation rate level to be below 2% in the FOMC projections that come out four times a year, the lessons of the financial crisis provide support for the higher2% long-run inflation goal of many of the other FOMC participants. However, does this support the raising of the inflation target to 4%, as Blanchard, Dell'Ariccia and Mauro (2010) seem to suggest?

The answer, to my mind, is no. The logic behind the view that a higher inflation target makes the zero lower bound on the policy rate less binding is of course correct. But we have to look not only at the benefits of a higher inflation target, but also at the costs. If it were no more difficult to stabilise the inflation rate at a 4% level than at a 2% level, then I think the case for raising the inflation target to 4% would be much stronger. However, the history of the inflation process suggests that this is not the case. Inflation rates that accord with the Greenspan definition of price stability, i.e. "the state in which expected changes in the price level do not effectively alter business or household decisions",[30] seem to be below the 3% level. Once inflation starts to rise above this level, the public is likely to believe that price stability is no longer a credible goal of the central bank and then the question arises, "if a 4% level of inflation is OK, then why not 6%, or 8%, and so on."

[30] Greenspan apparently first expressed this definition in the July 1996 FOMC meeting (page 51 of the transcript, which can be found at http://www.federalreserve.gov/monetarypolicy/files/FOMC19960703meeting.pdf). This definition was later made public in numerous speeches.

As was discussed earlier, economists such as Paul Samuelson and Robert Solow argued that policy-makers should be willing to tolerate higher inflation rates in the 4 to 5% range. But we have seen that when inflation rises above the 3% level, it tends to keep on rising. This was the experience in the United States in the 1960s that eventually led to the Great Inflation period from the 1970s to the early 1980s. Getting inflation back down again during the Volcker era was very costly. No central banker wants to go through that cycle again.

A second consideration is that the benefits of a higher inflation target only accrue when the zero lower bound becomes a binding constraint. Although this has surely been a major problem during the recent episode, it must be remembered that episodes like this are not very frequent. Indeed, we have not experienced a negative shock to the economy of this magnitude for over seventy years. If shocks of this magnitude are rare, then the benefits of a higher inflation target are not very large because they are only available infrequently. On the other hand, the costs of higher inflation in terms of the distortions it produces in the economy are continuous. Thus, although they may not be that large in any given year, these costs add up, and in present value terms far outweigh the intermittent benefits obtained from the zero lower bound not being binding in periods like the current one.

6.1.2 PRICE LEVEL TARGETING

Although the commitment to a strong nominal anchor for countries that have an independent monetary policy has taken the form of a target for inflation, an alternative is to target a price level path instead. Theoretical research starting in the late 1990s (e.g. Svensson (1999), Woodford (2002), Ditmar, Gavin and Prescott (1999, 2000) and Vestin (2000, 2006)) demonstrated that a price-level target produces less output variance than an inflation target. Indeed, as expressed by Woodford (2003), a price-level target makes policy history-dependent and this produces improved economic outcomes. The reasoning is straightforward. A negative demand shock that results in a lower price level requires monetary policy to try to raise the price level back to its target path, and this means that inflation is expected to rise in the short run to a level above the long-run inflation target embedded in the price-level target path. The rise in

expected inflation then lowers the real interest rate, thereby stimulating aggregate demand and economic activity. Hence, a price-level target is an automatic stabiliser: a negative demand shock leads to stabilising expectations, which stabilise the economy. This mechanism is even more effective when the negative demand shock is so large that the zero lower bound on nominal interest rates becomes binding, as Eggertsson and Woodford (2003) point out.

There are, however, some potential costs to price-level targets. A traditional objection, forcefully articulated by Fischer (1994), is that a price-level target can produce more output variability than an inflation target because unanticipated shocks to the price level are not treated as bygones and must be offset.[31] A price-level target requires that any overshooting or undershooting of the target must be reversed, and this can impart significantly more volatility to monetary policy, and, with sticky prices, to the real economy in the short run. An additional problem with a price-level target is that it is harder to communicate, particularly if it has an upward trend, which is required if the optimal long-run inflation rate is positive in order to make deflations a less frequent occurrence and the zero lower bound constraint less likely to bind. In this case, a price-level target would be a moving target and so harder to explain than an inflation target, which is always kept at a constant level.

The lesson from the financial crisis that the zero lower bound problem is more serious than was previously contemplated suggests larger benefits of a price-level target, which may outweigh the costs. Although the communication challenges are serious, [32] the potential benefits of price-level targeting may prompt central banks to look into ways of effectively communicating a price-level target to the public. For example, a central bank could indicate that in the event that it undershoots its inflation target for a period of time, as is occurring currently in many countries, it would be willing to tolerate a higher inflation rate in the short run in order for the average inflation rate over a longer horizon to meet the target objective. For this strategy to work, however, it would be crucial for the central bank to make it clear, and convince the public, that in

[31] This view is supported by simulations of econometric macro models with backward-looking expectations, which typically find that a price-level target leads to greater variability of output and inflation than an inflation target. E.g. see Haldane and Salmon (1995).
[32] This is why I argued in favour of inflation targeting over price-level targeting in the past (Mishkin (2001b)).

so doing it would not be raising its long-run inflation objective, and that its commitment to stabilising inflation would therefore remain as strong as ever.

6.2 RISK MANAGEMENT AND GRADUALISM

As discussed earlier, a key element of the analysis of optimal monetary policy is the linear-quadratic framework in which financial frictions do not play a prominent role. Although the linear-quadratic framework might be reasonable under normal circumstances, we have learned that financial disruptions can produce large deviations from these assumptions, indicating that the linear-quadratic framework may provide misleading answers for monetary policy strategy when financial crises occur.

The important role of nonlinearities in the economy arising from financial disruption suggests that policy-makers shouldnot 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.

What would this risk management approach look like? The first element of this approach is that monetary policy would act pre-emptively when financial disruptions occur. Specifically, monetary policy would focus on what I have referred to as *macroeconomic risk* (Mishkin (2010b)) – that is, an increase in 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. Monetary policy would aim at reducing macroeconomic risk by cutting interest rates to offset the negative effects of financial turmoil on aggregate economic activity. 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.

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 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.[33]

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

[33] 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" that will be discussed below.

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 (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.

6.3 THE LEAN VERSUS CLEAN DEBATE

The lean versus clean debate initially focused on whether monetary policy should react to potential asset price bubbles. In thinking about this debate, it is worth first distinguishing between two different types of asset price bubbles. We can then see how this bears on the lean versus clean debate and go on to examine the different policy options for responding to potential bubbles.

6.3.1 TWO TYPES OF ASSET PRICE BUBBLES

As pointed out in Mishkin (2010b), not all asset price bubbles are alike. Financial history and the financial crisis of 2007-09 indicate that one type of bubble, which is best referred to as a *credit-driven bubble*, can be highly dangerous. 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 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 can endanger the operation of the financial system as a whole.

However, 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.

6.3.2 THE CASE FOR LEANING VERSUS CLEANING

We have learned from the recent crisis that not only can the bursting of credit-driven bubbles be extremely costly, but also very hard to clean up after. Furthermore, bubbles of this type can occur even if there is price and output stability in the period leading up to them. Indeed, a period of price and output stability might actually encourage credit-driven bubbles because it leads market participants to underestimate the amount of risk in the economy. The case for leaning against potential bubbles rather than cleaning up after them has therefore become much stronger.

However, the distinction between the two types of bubbles, one of which (credit-driven) is much more costly than the other, suggests that the lean versus clean debate may have been misguided, as White (2009) indicates. Rather than leaning against potential asset price bubbles – including both credit-driven and irrational exuberance bubbles – there is a much stronger case for only leaning against credit-driven bubbles, and not irrational exuberance bubbles. As White (2009)

and Mishkin (2010b) have pointed out, it is much easier to identify credit 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 bubbles.

6.3.3 MACRO-PRUDENTIAL POLICIES

There is a strong case for leaning against credit bubbles, but what policies will be most effective? First, it is important to recognise that the key principle to consider in 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. Upon recognising 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 is still 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, and is referred to as *macro-prudential regulation and 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.[34] It is important for research to continue to analyse the role of bank capital requirements in promoting financial stability, including whether capital requirements should be adjusted over the business cycle. 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.[35]

Some policies aimed at addressing the risks to financial stability from asset price bubbles could be made a standard part of the regulatory system, to be operational at all times – whether a bubble was in progress or not. However, because specific or new types of market failures might be driving a particular credit bubble, there is a case for discretionary prudential policies aimed at limiting the market failures in such a case. For example, during certain periods risks across institutions might become highly correlated, and discretionary policy aimed at responding to these higher-stress environments could help reduce systemic risk.

6.3.4 MONETARY POLICY

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".

[34] For example, see Kashyap and Stein (2004) and Adrian and Shin (2009).
[35] For example, see Bank of England (2009) and French et al. (2010).

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.

Monetary policy can also encourage risk-taking in two other ways. Although desirable from the viewpoint of establishing credibility and a strong nominal anchor, more predictable monetary policy can reduce uncertainty and encourage asset managers to underestimate risk (Gambacorta (2009)). Monetary policy that cleans up after financial disruptions by lowering interest rates, which has been named the “Greenspan put” because this was the actual and stated policy of the Federal Reserve when Alan Greenspan was at the helm, can lead 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)). The Greenspan put can also increase systemic risk because it is only exercised when many financial firms are in

trouble simultaneously, and so they may be encouraged to pursue similar investment strategies, thereby increasing the correlation of returns.

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.

Given the evidence relating to the risk-taking channel, should monetary policy be used to lean against credit 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.[36] 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?

[36] 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. Press reports suggest that the capital standards in the accord were substantially weakened because of complaints by the German Landesbanken. Furthermore, 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. The Basel III 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.[37] But this raises another objection to using monetary policy to lean against credit bubbles: it may not work. I am sympathetic to the view discussed earlier that 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. Furthermore, the theoretical analysis discussed immediately above suggests that 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,

[37] 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.

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.[38]

Nonetheless, using monetary policy to lean against credit bubbles is not a monetary policy strategy that can be taken lightly. Doing so could at times result in a weaker economy than the monetary authorities would desire, or inflation that is too low. This suggests that there is a monetary policy tradeoff between the pursuit of financial stability and the pursuit of price and output stability. Also as mentioned earlier, giving monetary policy another objective might lead to confusion about the central bank's commitment to price stability, thereby weakening the nominal anchor, 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 policy-makers, and especially monetary policy-makers, want tools to assess whether credit bubbles are developing. Research is underway (e.g. as described in Borio and Lowe (2002) and Adrian and Shin (2010)) to find measures that will signal whether credit bubbles are likely to be forming. High credit growth, increasing leverage, low risk spreads, and surveys to assess whether credit underwriting standards are being eased are factors that can help central banks decide if there is an 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.

This danger of considering using monetary policy to promote financial stability is highly relevant today. Some economists, for example Hoenig (2010) and Rajan (2010), have called for the Federal Reserve to raise interest rates because they argue that the current low rates are encouraging excessive risk-taking. However, the US economy is currently not in a situation of

[38] Monetary policy leaning against credit bubbles can also be thought of as a form of risk management because it pre-emptively takes measures to restrain credit bubbles. As in the risk management approach discussed earlier, the justification for pre-emptively leaning against credit bubbles is the presence of nonlinearities in the economy, so that monetary policy is used to take out insurance against the high cost of the bubble when it bursts.

rapid credit growth, low risk premiums and increasing leverage. Indeed, it still seems to be mired in a deleveraging cycle that is producing serious headwinds for the economy. This doesn't mean that the situation cannot change. However, at the current juncture, low interest rates do not appear to be creating the next credit bubble in the United States, and justification for raising them to curb risk-taking is lacking.

On the other hand, many emerging market economies and some advanced economies like Israel are currently in a very different environment because they did not go through a deleveraging cycle such as occurred in the United States and Europe. They thus have the potential for a credit bubble to develop, and low US interest rates are a potential danger because they could promote excessive risk-taking.[39] In these countries, however, the option of tightening monetary policy to restrict risk-taking may not be available because raising interest rates would just encourage capital inflows that could also promote a credit boom. For these countries the only option may be to pursue macro-prudential policies to limit credit growth.[40]

6.4 DICHOTOMY BETWEEN MONETARY POLICY AND FINANCIAL STABILITY POLICY

Another lesson learned from the financial crisis and the discussion above is that monetary policy and financial stability policy are intrinsically linked to each other, and so the dichotomy between them is a false one. As we have seen, monetary policy can affect financial stability, while macro-prudential policies to promote financial stability can have an impact on monetary policy. 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

[39] The empirical research in Ioannidou et al. (2009), which indicated that loans became riskier in Bolivia when US interest rates were low, is particularly relevant on this point.

[40] These might take the form of policies to restrict capital inflows, but with a focus on restricting credit growth rather than blocking financial globalisation.

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.

I have argued elsewhere (Mishkin (2009c) and in French et al. (2010)) that the recent financial crisis provides strong support for a systemic regulator and that central banks are the natural choice for this role. The benefits of coordination between monetary policy and macro-prudential policy provide another reason for having central banks take on the systemic regulator role. Coordination of monetary policy and macropudential policy is more likely to be effective if one government agency is in charge of both. As anyone who has had the pleasure of experiencing the turf battles between different government agencies knows, coordination of policies is extremely difficult when different entities control these policies.

7 CONCLUDING REMARKS

The bad news is that we have just been through a once-in-a-century credit tsunami that has had a devastating impact on the economy, one that will last for years to come. The good news is that macro/monetary economists and central bankers do not have to go back to the drawing board and throw out all that they have learned over the last forty years. Much of the science of monetary policy remains intact. The case for the basic monetary policy strategy, which for want of a better name I have called flexible inflation targeting, is still as strong as ever, and in some ways more so.

The recent financial crisis, however, has necessitated some major rethinking regarding the details of this basic framework for monetary policy strategy. We now recognise that the financial sector plays a very prominent role in the macroeconomy, and makes it highly nonlinear at times. This requires that we abandon the linear-quadratic framework for considering how to conduct monetary policy when there is a financial disruption. There is now a stronger case for a risk management framework that factors in tail risks that can produce very adverse outcomes for the economy. Another lesson is that there is a stronger case in favour of monetary policy leaning against credit bubbles (but not asset price bubbles per se), rather than just cleaning up after the

bubble has burst. Using monetary policy to pursue financial stability goals is not an easy task, however, and research on how to monitor credit conditions so that decisions to use monetary policy to restrict excessive risk are based on the correct information will be a high priority for researchers in the future. Finally, the financial crisis has made it clear that the interactions between the financial sector and the aggregate economy imply that monetary policy and financial stability policy are closely intertwined.

There is one other piece of good news that has emerged from this crisis. The field of macro/monetary economics has become considerably more exciting. We are now faced with a whole new agenda for research that should keep people in the field very busy for a very long time. It has also made the work of central bankers more exciting as well. They now have to think about a much wider range of policy issues than they had to previously. This will surely be exhausting, but central banking will be a far more stimulating profession as a result.

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