Monetary Policy Strategy: Lessons from the Crisis

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Up until August 2007, advances in both theory and empirical work in the study of monetary economics had led both academic economists and policymakers to argue that there was now a well defined "science of monetary policy". There was a general consensus in 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 since the early 1980s was dubbed the "Great Moderation". Monetary economists and central bankers were feeling pretty good about themselves.

Then, starting in August 2007, the world was hit by what Alan Greenspan, former Chairman of the Fed, described as a "once-in-a-century credit tsunami". The tsunami from the 2007-2009 financial crisis, not only flattened economic activity, producing the most severe world-wide economic contraction since the Great Depression, but it also seemed to sweep away confidence in the ability of central bankers to successfully manage the economy.

This paper examines what we have learned and how we should change our thinking about monetary policy strategy in the aftermath of the 2007-2009 financial crisis. It starts with a discussion of where the science of monetary policy was before the crisis and how central banks viewed monetary policy strategy. It will then examine how the crisis has changed the thinking of both macro/monetary economists and central bankers. Finally, it will look at what implications this change in thinking has had on monetary policy science and strategy.

I.
The Science of Monetary Policy Before the Crisis

To examine where the state of monetary policy analysis was before the crisis, I will draw heavily on a paper that I wrote just before crisis began, which was presented at a conference at the Bundesbank in September of 2007 (2009a). In that paper I outlined nine basic scientific principles, derived from theory and empirical evidence that guided thinking at almost all central banks: 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 were agreed to by almost all academic economists and central bankers. The last principle that financial frictions play and important role in business cycles was not explicitly part of models used for policy analysis in central banks, but was well understood by many, although not all central bankers. Because a key issue will be whether recent events overturn these principles, it is worth spending a fair amount of time understanding the theoretical and empirical basis for each of them below.

Nine Basic Principles

1. Inflation is Always and Everywhere a Monetary Phenomenon.

By the 1950s and 1960s, the majority of macroeconomists had converged on a consensus view of macroeconomic fluctuations that downplayed the role of monetary factors. Much of this consensus reflected the aftermath of the Great Depression and Keynes' seminal *The General Theory of Employment, Interest, and Prices*, which emphasized shortfalls in aggregate demand as the source of the Great Depression and the role of fiscal factors as possible remedies. In contrast, research by Milton Friedman and others in what became known as the "monetarist" tradition (Friedman and Meiselman, 1963; Friedman and Schwartz, 1963a,b) 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, as well as 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 the Friedman's famous adage, "Inflation is always

and everywhere a monetary phenomenon" (Friedman 1963, p. 17), as long as inflation is referring to a sustained increase in the price level (e.g., Mishkin, 2010a).

General agreement with Friedman's adage did not mean that all economists subscribed to the view that the 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 imprint of this line of thought was that central bankers came to recognize 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 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 of 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 may boost the costs of borrowing. Finally, some households undoubtedly do not fully understand the implications of a general trend in prices--that is, they may suffer from nominal illusion--making financial planning more difficult.[1] The total effect of these distortions became more fully appreciated over the course of the 1970s, and the recognition

[1] Of course, economic theory implies that inflation can be either too high or too low. The discussion has emphasized 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 some 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.

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.[2, 3]

3. There is No Long-Run Tradeoff Between Unemployment and Inflation.

A paper published in 1960 by Paul Samuelson and Robert Solow (1960) argued that work by A.W. Phillips (1958), which became known as the Phillips curve, suggested that there was a long-run tradeoff between unemployment and inflation and that this tradeoff should be exploited. Under 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 nonperfectionist goal of a 3 percent unemployment rate could be achieved at what they considered to be a not-too-high inflation rate of 4 percent to 5 percent 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. Indeed, the economic record from the late 1960s through the 1970s was not a happy one: Inflation accelerated, with the inflation rate in the United States and other industrialized countries eventually climbing above 10 percent in the 1970s, leading to what has been dubbed "The Great Inflation."

The tradeoff suggested by Samuelson and Solow was hotly contested by Milton Friedman (1968) and Edmund Phelps (1968), who independently argued that there was no long-run tradeoff between unemployment and the inflation rate: Rather, the economy would gravitate to some 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

[2] 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.

[3] The deleterious effects of inflation on economic efficiency implies that the level of sustainable employment is probably lower at higher rates of inflation. Thus, the goals of price stability and high employment 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, 2007b).

hypothesis was immediately influential and fairly quickly began to be incorporated in 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 adopted the natural rate, or no-long-run-tradeoff, view. Of course, the earlier discussion of the benefits of price stability suggests a long-run tradeoff--but not of the Phillips curve type. Rather, low inflation likely contributes to improved efficiency and hence higher employment in the long run.

4. Expectations Play a Crucial Role in the Macro Economy.

A key aspect of the Friedman-Phelps natural rate hypothesis was that sustained inflation may initially confuse firms and households, but in the long run sustained inflation would not boost employment because *expectations* of inflation would adjust to any sustained rate of increase in prices. Starting in the early 1970s, the rational expectations revolution, launched in a series of papers by Robert Lucas (1972, 1973, and 1976), took this reasoning a step further and demonstrated that the public and the markets' expectations of policy actions have important effects on almost every sector of the economy.[4] The theory of rational expectations emphasized that economic agents should be driven by optimizing behavior, and therefore their expectations of future variables should be optimal forecasts (the best guess of the future) using all available information. Because the optimizing behavior posited by rational expectations indicates that expectations should respond immediately to new information, rational expectations suggests that the long 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 policymakers' 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

[4] 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.

emphasized in the recent synthesis of Michael Woodford (2003).[5] And this insight has far-reaching implications, for example, with regard to the types of systematic behavior by policymakers that are likely to be conducive to macroeconomic stability and growth.[6]

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 the comparison of economic performance under different monetary policy rules.[7] One type of rule that has received enormous attention in the 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).[8] Taylor (1993) emphasized that a rule of this type had desirable properties and in particular would stabilize inflation only if the coefficient on the inflation gap exceeded unity. This conclusion came to be known as the "Taylor principle" (Woodford, 2001) and can be described most simply by saying that stabilizing 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

[5] 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,b, 1983), the rational expectation revolution's point that monetary policy's impact on the economy is substantially influenced by whether it is anticipated or not has become widely accepted.

[6] Of course, the recognition that management of expectations is a central element in monetary policymaking raises to the forefront the credibility of monetary policy authorities to do 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 the actions consistent with how they want expectations to be managed.

[7] Although Lucas (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 the comparison of economic performance arising from different rules.

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

experienced during this period.[9] Indeed, as inflation rose in the United States, real interest rates fell.[10]

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 revolutions 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, policymakers may find it tempting to exploit a short-run Phillips curve tradeoff between inflation and employment; but private agents, cognizant of this temptation, will adjust 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;* the optimal plan can be *time-inconsistent* and so will soon be abandoned. The notion of time-inconsistency has led to a number of important insights regarding central bank behavior--such as the importance of reputation (formalized in the concept of *reputational equilibria*) and institutional design.

7. Central Bank Independence Improves Macroeconomic Performance.

Indeed, the potential problem of time-inconsistency has led to a great deal of research that examines the importance of institutional features that can give central bankers the commitment mechanisms they need to pursue low inflation. Perhaps the most significant has been research showing that central bank independence, at least along some dimensions, is likely very important to maintaining low inflation. Allowing central banks to be instrument independent, i.e., to control the setting of monetary policy instruments, can help insulate them

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

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

from short-run pressures to exploit the Phillips-curve tradeoff between employment and inflation and thus avoid the time-inconsistency problem.[11]

Evidence supports the conjecture that macroeconomic performance is improved when central banks are more independent. When central banks in industrialized 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).[12]

Although there is a strong case for instrument independence, the same is not true for goal independence, the ability of the central bank to set its own goals for monetary policy.[13]
In a democracy, the public exercises control over government actions, and policymakers are accountable, which requires that the goals of monetary policy be set by the elected government. Although basic democratic principles argue for the government setting 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 set a short-run inflation or exchange rate target that was 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.

[11] For an example of how the time-inconsistency problem can be modeled as 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 that the central bank will be forward looking and adequately allow for the long lags from monetary policy actions to inflation in setting their policy instruments.

[12] A case study that provides a striking example of the benefits of instrument independence.
occurred with the granting of instrument independence to the Bank of England in May of 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 1995-96 the U.K. retail inflation rate (RPIX) was fairly close to 3 percent, but the spread between nominal and indexed bond yields--referred to as 10-year breakeven inflation--was substantially higher, in the range of 4 percent to 5 percent, 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.

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

However, the length of the lags from monetary policy to 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 judgment and expertise regarding the nature of the inflation process and its interaction with real activity. That need for judgment and expertise argues 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 that a credible commitment to a nominal anchor--i.e., stabilization 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 establishing 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 the government 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--the issuing/printing of money to pay for goods and services that 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 stabilize inflation expectations, which reduce 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 that 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 lower volatility of output fluctuations (Fatás, Mihov, and Rose, 2007; Mishkin and Schmidt-Hebbel, 2002, 2007).

Commitment to a nominal anchor can also help stabilize output and employment. Specifically, to counter a contractionary demand shock, the monetary authorities need 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, if the private sector becomes 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. The 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 might 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 stabilizing economic activity in the face of adverse demand shocks.

9. Financial Frictions Play and Important Role in the Business Cycle.

Research that outlined how asymmetric information could impede the efficient functioning of the financial system (Akerlof, 1970; Myers and Majluf, 1984; and 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 so that financial frictions increase dramatically, financial instability results, and the financial system is no longer able to channel funds to those with productive investment opportunities, with the result that the economy can experience a severe economic downturn (Mishkin, 1997). The rediscovery of Irving Fisher's (1933) paper on the Great Depression 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 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). The 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 the 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 like FRBUS in use at the Federal Reserve, did not allow for the impact of financial frictions and disruptions on economic activity.

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 maximizes this objective function subject to constraints that are 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.

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, and Woodford, 2003). The benefits of price stability (principle 2) is eflected in the first component which involves minimizing 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 underutilized resources in the economy and involves minimizing 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), optimal monetary policy requires taking account of the intertemporal nature of economic welfare and requires maximizing the objectives both for the present state of the economy and the expected path in future periods. Because inflation is a monetary phenomenon and is thus viewed

as controllable by monetary policy (principle 1), the central bank sets its policy instruments (in normal times, a short-term interest rate) to maximize the objective function subject to the constraints.

Constraints: The Model. The constraints as embodied in macro-econometric models in use at central banks before the crisis also reflected 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 behavior (principle 4) and lead to the existence of the time-inconsistency problem (principle 5), and the need for a credible commitment to a strong nominal anchor to produce good monetary policy outcomes (principle 8) which 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 stabilize inflation (Taylor principle 5).

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 neoclassical synthesis. However, the approach to analyzing 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 behavior 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 characterized 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).

Representative-Agent Framework. The models also contained another additional feature, a representative-agent framework in which all agents are alike so that financial frictions are not present because they require that agents 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 that financial frictions could have an important effect on economic activity, financial frictions were not a key

feature in the macro-econometric models used in central banks and were not an element of the pre-crisis theory of optimal monetary policy.

II.
Monetary Policy Strategy Before the Crisis

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

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 stabilize inflation in the long run, often at an explicit numerical level, but also allows for the central bank to pursue policies to stabilize output around its natural rate level in the short run.

The phrase "inflation targeting" to describe this monetary policy strategy i 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 have announced an explicit numerical inflation objective and treat it as a target, and these are classified a full-fledged inflation targeters, while others are reluctant to be so explicit. For example, the Federal Reserve has espoused a strong commitment to stabilize inflation, but has not been willing to announce an explicit inflation objective. Instead, the Federal Reserve reports on the individual FOMC participants' projection of inflation in the long run under "appropriate monetary policy". In effect, the Fed 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 not 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 all have been in a pretty tight range between 1 ½ and 2%, and so they are not far from committing to a specific inflation objective and not very large modifications in their communication strategy would move them to the inflation targeting camp (Mishkin, 2008). In other cases, such as the European Central Bank or 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 stabilize inflation in the long run. Indeed, Svensson (20xx) argues that any central bank that indicates that it will pursue the standard objective function which involves minimizing 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.

Certainty Equivalence, Gradualism and Risk Management

Under the assumptions of the linear quadratic framework, the optimal policy is certainty equivalent: This policy can be characterized by a linear time-invariant response to each shock, and the magnitude of these responses does not depend on the variances or 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 characterized by considerable inertia, which is commonly referred to as gradualism.[14]

Indeed, the actual course of monetary policy before the crisis was typically been very smooth in the United States as well as in many other industrial economies. For example, the Federal Reserve usually adjusted the federal funds rate in increments of 25 or 50 basis points (that is, 1/4 or 1/2 percentage point) and sharp reversals in the funds rate path were rare. Numerous empirical studies have characterized monetary policy before the crisis using Taylor-style rules in which the policy rate responds to the inflation gap and the output gap; these studies have generally found that the fit of the regression equation is improved by including a lagged interest rate that reflects the smoothness of the typical adjustment pattern.[15]

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

The 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, 20xx), 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

[14] 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).

[15] Clarida, Gali, and Gertler (1998, 2000); Sack (2000); English, Nelson, and Sack (2003); Smets and Wouters (2003); Levin, Onatski, and Williams (2005); further discussion is in Bernanke (2004).

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.

Dichotomy Between Monetary Policy and Financial Stability Policy

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 modeling 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 should be conducted separately. Monetary policy instruments would focus on minimizing 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 characterize most central bankers as having supportied the dichotomy between monetary policy and financial stability policy, there were views that monetary policy should address financial stability issues, particularly with regard to responding to potential asset price bubbles.

Response of Monetary Policy to Asset Price Bubbles: the "Lean" Versus "Clean" Debate

An 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 whether it should respond at all but whether it should respond over and above the response called for in terms of objectives to stabilize inflation and employment. Another way of stating the issue is whether monetary policy should try to pop, or slow the growth of possibly developing asset-price bubbles to minimize damage to the economy when these bubbles burst? Alternatively, should the monetary authorities not respond directly to possible asset price bubbles, but instead should respond to asset price declines only after a bubble bursts to stabilize both output and inflation? These two positions have been characterized 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 characterized as 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) has emphasized, the departure of asset prices from fundamentals can lead to inappropriate investments that decrease the efficiency of the economy. Furthermore, the bursting of bubbles throughout history has been followed by sharp declines in economic activity, as Kindleberger's (1978) famous book demonstrated.

The clear cut dangers of asset-price bubbles led some economists before the crisis, both inside and outside central banks —such as 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 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).[16] There are several elements of 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

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

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

A second objection against leaning against bubbles is that raising interest rates may be very ineffective in restraining the bubble, because market participants expect such high rates of return from buying bubble-driven assets.[17] By definition, bubbles are departures from the behavior that is normally incorporated within models, and so the tools of monetary policy are unlikely to work normally in abnormal conditions.

A third objection is 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 would be 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 suggest that raising interest rates would 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; and 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 1989 in Japan) have suggested that raising interest rates may cause a bubble to burst more severely, thereby increasing the damage to the economy.[18] Another way of saying this is that bubbles are departures from normal behavior, 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 had 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 true even if interest rates fell and approached the zero lower bound, and so the conventional tool of lowering the policy interest rate was no longer an option. The economy could be stimulated by either: 1) managing expectations so that the policy rate would be viewed

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

as staying low for an extended period, thereby lowering long-term interest rates, 2) risk and term premiums could be lowered by purchasing securities, thereby changing their relative supply, and 3) by exchange rate interventions to lower the value of the domestic currency, thereby increasing foreign demand for domestic production.[19]

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 it was 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 from this analysis was that the cost of leaning against asset-price bubbles was likely to be high, while the costs of a bursting bubbles could be kept low. Instead of trying to lean against bubbles, central banks should just clean up after the bubble afterwards. This approach was fully consistent with monetary policy focusing on stabilizing 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 about its objectives. As reported in Giavazzi and Mishkin (2006), interviews with participants from different sectors of Swedish society suggested that statements on house prices by the 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 several meetings in 2004, a minority of members of the Monetary Policy Committee (MPC) of the Bank of England argued for raising interest rates more than could be justified in terms of the Bank of England's objectives for inflation over its normal policy horizon.[20] According to the minutes of those meetings, the advocates believed that such a move would reduce the risks that high house-price appreciation and the rapid accumulation of household debt would lead to an abrupt adjustment process, with serious

[19] E.g., see Svensson (20xx), Reinhart (2003), Bernanke (2004).
[20] Bank of England (2004), MPC Minutes, January, p. 8; March, p. 9; April, p. 9; and August, p. 9.

negative consequences for the economy.[21] Mervyn King, the Governor of the Bank of England, did not advocate leaning against the wind but did suggest that, to prevent a buildup of financial imbalances, a central bank might extend the horizon over which inflation is brought back to target (King, 2004a,b). Statements from officials at the European Central Bank and other central banks also suggested that the possibility of an asset boom or bust might require a longer period than the usual one to two years in assessing whether the price stability goal was being met (Issing, 2003a,b; Gjedrem, 2003; Stevens, 2004; Selody and Wilkins, 2004; Bank of Canada, 2006; and Rosenberg, 2006).

III.
How Has the Crisis Changed Our Thinking?

The global financial crisis of 2007-2009 was not only a tsunami that flattened the economy, but in the eyes of some commentators it has flattened the science of monetary policy, requiring a total rethink. Armed with the understanding of where the science of monetary policy was before the crisis, we can ask what 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 financial sector have a far greater impact on economic activity than we earlier realized.

Although central bankers generally recognized that financial frictions could play an important role in business cycle fluctuations, the 2007-2009 financial crisis made it clear that the adverse effects of financial disruptions on economic activity could be far worse than was anticipated for advanced economies. When the financial crisis started in August 2007, central bank actions to contain it seemed to be working. Many officials at the central banks, although still concerned about the disruption to the financial markets, hoped that the worst was over and that the financial system would begin to recover (see Mishkin, 2011). The subprime mortgage

[21] Bank of England (2004), MPC Minutes, March, p. 8.

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 inside the Federal Reserve whether the easing phase of monetary policy might have to be reversed in order to contain inflation (e.g., see Wessel, 2009).

But then came a set of shocks which sent the financial system and the economy over the cliff: the Lehman Brothers bankruptcy on September 15, 2008, the AIG collapse on September 16, the run on the Reserve Primary Fund on the same day, and the U.S. Treasury's struggle to get the TARP plan approved by U.S. Congress over the next couple of weeks (Mishkin, 2011). The financial crisis now morphed into a global crisis that caused a sharp drop in economic activity in the United States – real GDP declined at an annual rate of -1.3% in 2008, Q4, -5.4% in 2009 Q1 and -6.4% in 2009 Q2 – but in the rest of the world as well – with real GDP falling at a -6.4% rate in the fourth quarter of 2008 and a -7.3% rate in the first quarter of 2009. The unemployment rate shot up to over 10% in the United States and in many other advanced economies, with the unemployment rate remaining stubbornly high even after the world economy started to recover. The world-wide recession that resulted from the financial crisis turned out to be the most severe economic contraction since the world-wide depression of the 1930s.

The global financial crisis of 2007-2009 therefore demonstrated that financial frictions should be front and center in macroeconomic analysis: they no longer could be ignored in the macro-econometric that models that central banks use for forecasting and policy analysis, as we saw was the case before the crisis. As a result, there is 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 literature that is in its infancy to explore how financial frictions would modify the prescriptions provided by the science of monetary policy.[22]

2. The macro economy is highly nonlinear.

Because economic downturns typically result in even greater uncertainty about asset values, such episodes may involve an adverse feedback loop whereby financial disruptions cause

[22] For example, set Gertler and Karadi (2009 and Curdia and Woodford (2009).

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.

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 are 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 incentives 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 after the Lehman Brothers bankruptcy showed how nonlinear both the financial system and the macro economy could be. In the aftermath of the Lehman Brothers bankruptcy, 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 spead) shot up dramatically. The subsequent economic downturn in which real GDP and world trade collapsed from the fourth quarter of 2008 through the first half of 2009, mentioned immediately above, also indicated that the macro economy can at times be highly nonlinear.

The role of nonlinearities in the macro economy 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 because on the assumption that the macro economy can be described by linear dynamic equations. The financial crisis of 2007-2009 demonstrates that although the linear-quadratic framework may provide a reasonable approximation to how monetary policy should operate under fairly normal circumstances, this approach will not be adequate for thinking about monetary policy when financial disruptions hit

the economy. [23] Furthermore, the use of a quadratic objective function does not reflect the extent to which most individuals have strong preferences for minimizing the incidence of worst-case scenarios, such as the one we have just experienced. Therefore, given that the central bank's ultimate goal should be to maximize the public welfare, the design of monetary policy ought to 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 the 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 in the recent crisis, the 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 realized.

As discussed earlier, before the crisis, central bankers recognized that the zero lower bound for nominal interest rates would require the use of nonconventional monetary policy when a contractionary shock caused interest rates to fall toward zero. One view is that the zero lower bound problem is more serious than originally contemplated because nonconventional 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 the severity of the recent economic downturn was that monetary policy was very aggressive and that it was effective.[24]

Nonconventional monetary policy took four forms: 1) liquidity provision in which central banks expanded lending to both banks and other financial institutions, 2) asset purchases

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

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

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 in which central banks committed to keep their policy rate at very low levels for a long period of time.

In evaluating liquidity provision, some research argues that there was little effect from these types of programs. 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 has challenged this conclusion by arguing that financial markets would react to the announcements of programs, 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) and McAndrews (2009), Goldberg, Kennedy and Miu (2010) find that the U.S. 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 in not only 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 stabilize financial markets during this crisis.

Research on the impact of the Fed's large-scale asset purchases during the global financial crisis by Gagnon, Raskin, Remache and Sack (2010), finds that these programs lowered long-term bond rates relative to short rates on the order of 50 basis points, and lowered MBS interest rates even further by improving liquidity in this market, thereby having a substantial impact on residential mortgage rates.

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

There is strong theoretical support for the management of expectations to stimulate 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 and 2004) and Woodford, 2003). Yet, the empirical evidence for how effective management of expectations was during this episode is not yet available.

What I take from all this evidence is that nonconventional monetary policy was effective during the recent financial crisis. I would also argue that conventional monetary policy was as well and was even more effective 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 of 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 this 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 than we saw, resulting in a far deeper recession and possibly even a depression. The problem during the financial crisis episode with conventional monetary policy 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 nonconventional, during the crisis was effective 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 a very serious problem 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 nonconventional monetary policy twice in the decade of the 2000s, once in 2003-2004 when it made a

commitment to keep interest rates low for a considerable period, and then during the 2009-2010 period, suggests that the zero-bound-problem may far more prevalent than the earlier research suggested and is 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 recognize that the macro economy 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 was previously anticipated. Again this results from the presence of nonlinearities and large tail risks. Sufficiently large contractionary shocks can make the magnitude of the costs of the zero-lower-bound constraint very large. Large contractionary shocks can thus overwhelm the ability of conventional policy to counteract them, and may require massive interventions in credit markets and expansion of their balance sheets by central banks. As I will discuss below, these massive interventions may have a very high cost for central banks down the road and so should be avoided if possible.

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 costs far higher. 1) financial crises are typically followed by very slow growth, 2) the budgetary position of governments' sharply deteriorates, and 3) the exit strategy for central banks from nonconventional monetary policy may be both complicated and hinder the ability of the central bank to successfully manage the economy in the future.

When economies experience deep recessions, the typical experience is that they subsequently have 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 analyzing fifteen severe post-World War II financial crises, the Great Depression the 1973 oil shock period and the recent crisis, they find that real GDP growth rates are significantly lower during the decade following this episodes, with the median decline in GDP growth being about 1%. Furthermore, unemployment rates stay persistently higher for the decade after crisis episodes, with the median unemployment rate five

percentage points higher in advanced economies. Although we have many years to go before a decade goes by after 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 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 recognize that the cumulative output losses from financial crises is massive, and this current crisis looks like it will be no exception.

As pointed out by Reinhart and Rogoff (2009), the aftermath of financial crises is almost always a sharp increase in government indebtedness. We have seen exactly this situation in the aftermath of the current crisis. The massive bailouts of financial institutions, fiscal stimulus packages, and the sharp economic contractions that reduced tax revenue that occurred throughout the world have adversely affected the fiscal situation for many countries. Budget deficits over 10% of GDP in advanced countries like the United States have become common. Furthermore, this rise in indebtedness has the potential to sovereign debt defaults, which has come become a serious concern in Europe after the Greek sovereign debt crisis and the problems that the Irish government is facing because of the spiraling 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 will increase societal stress. Indeed, there is even a possibility that the fiscal problems brought on by the crisis could lead countries to exit the Euro.

Actions by central banks to contain 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 of the liquidity facilities have provided 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 ranks, 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 stem 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 concern would be more worrisome if an expansion in the monetary base is closely

linked to inflation, but this is unlikely to be the case in the current environment. The huge increase in the monetary base from August 2007 to the end of 2009 of 144.6% 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 that asset market purchases were often for long term securities which exposes the central bank to interest risk (and credit risk if it buys private securities like 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 the 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. [25]

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 monetizing the debt. This is a particular concern right now in the Eurozone, where the ECB has purchased securities issued by governments that not only have large fiscal imbalances, but in the case of Greece, even lied about its fiscal position. This problem is also a serious concern in the United States, where both political parties have been unwilling to address long-run trends in entitlements that could cause U.S. 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, that could make it difficult for the central bank to control inflation in the future.[26]

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

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

5. Price and output stability does 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) which indicated that monetary policy which optimally stabilizes inflation and output is likely to stabilize asset prices, making asset-price bubbles less likely. Indeed, central bank's success in stabilizing inflation and the decreased volatility of business cycle fluctuations, which became known as the Great Moderation, made policymakers complacent about the risks from financial disruptions.

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

IV.
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.[27] Indeed, Krugman titled his 2009 New York Times Magazine article "How Did

[27] See Lucas (2009) and Cochrane (2009) for spirited replies to both the Economist (2009) and Krugman (200(9) articles.

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 policymakers 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 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.

Basic Principles of the Science of Monetary Policy

The lessons from the crisis are 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 that cleaning up after financial crises can have very high costs; and that price and output stability do not ensure financial stability. One reason why I spent so much time earlier in the paper on the theory and empirical work that supports the nine principles of the science of monetary policy is that we can ask whether any of the lessons from the crisis refute the justification for those principles. When you go through 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 undermines or invalidates the nine basic principles of the science of monetary policy developed before the crisis.***

Each of the five lessons from the crisis are 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 italicized 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 does indicate that the ninth principle about financial frictions is of course valid, but now is even more important than central bankers previously realized.

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 macro economy is inherently nonlinear undermines the linear-quadratic framework that is a key element of the pre-crisis theory of optimal monetary policy. The lesson that the developments in the financial sector can have a major impact on economic activity undermines the representative-agent framework that is 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.

V.
Implications for Monetary Policy Strategy

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

Flexible Inflation Targeting

The monetary policy strategy that follows from the eight principles of the new neoclassical synthesis is what I have referred to, for want of a better name, as flexible inflation targeting. Since, as I have argued here, none of these principles is invalidated by the events of the recent financial crisis, this approach to monetary policy strategy is still equally valid. The support for central banks' adhering to the principles of the new neoclassical synthesis is still every bit as strong as it was before the crisis. Therefore, there is still strong support for a central bank to have a strong, credible commitment to stabilize inflation in the long run, but also to have the flexibility to pursue policies to stabilize 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, they do suggest, however, that the details of how flexible inflation targeting is conducted and what flexibility means need to be rethought. We 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 should be used.

Level of the Inflation Target. Because the financial crisis has shown that the zero-lower-bound problem can be more serious than previously thought, there is a question of whether the optimal level of the inflation rate that central banks target should be higher than the typical value of around the 2% level. 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 as low as negative 4%, rather than negative % with the 2% inflation target. Conventional monetary policy, which involves manipulating the nominal policy rate, would then be able to ease monetary policy by more than it otherwise 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 less than 2% might be undesirable. Some FOMC participants have expressed their desired level of the long-run inflation rate to be below 2% in the FOMC projections that come out four times a year, and the lessons of the financial crisis provide support for the higher 2% long-run inflation goal of many of the other FOMC participants. However, does this argument support raising 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 not only have to look at the benefits of a higher inflation target but also the costs. If it were no more difficult to stabilize 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 which accord with the Greenspan definition of price stability that it "is the state in which expected changes in the price level do not effectively alter business or household decisions,"[28] 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

[28] 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.

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."

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. As was discussed earlier, economists such as Paul Samuelson and Robert Solow argued that policymakers should be willing to tolerate higher inflation rates in the 4 to 5% range. When these levels of inflation were reached, inflation rates continued to rise beyond that level, producing the Great Inflation period in the 1970s and 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 in this recent episode, it must be remembered that episodes like this have not come very often. 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 to a higher inflation target will not be very large because the benefits will only be available infrequently. On the other hand, the costs of higher inflation in terms from the distortions it produces in the economy are ongoing. 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 having the zero lower bound not be binding in periods like the current one.

Price Level Targeting. Although for countries the commitment to a strong nominal anchor for countries which 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, 1999, Ditmar and Gavin, 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 will require monetary policy to try to raise the price level back to its target path and this will mean that inflation will be expected to

rise in the short run above the long-run inflation target embedded in the price-level target path. The rise in expected inflation will then lower the real interest rate, thereby stimulating aggregate demand and economic activity. Hence, a price-level target is an automatic stabilizer: a negative demand shock leads to stabilizing expectations that stabilize 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.[1] A price-level target requires that overshoots or undershoots of the target must be reversed and this could 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 would be harder to communicate, particularly if it has an upward trend, which would be required if the optimal long-run inflation rate is positive in order to make deflations a less frequent occurrence and also the zero-lower-bound-constraint be 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 argues for larger benefits of a price-level target that may outweigh the costs. Although the communication challenges are serious, [29] the potential benfits of price-level targeting suggest that central banks might look into how to effectively communicate a price-level target to the public. For example, the central bank could indicate that when 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 so that the average inflation rate over a longer horizon would meet the target objective. It would be crucial, however, for the central bank to make clear and convince the public that by so doing, it would

[1]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).

[29] This is why I argued in favor of inflation targeting over price level targeting in the past, Mishkin (2000).

not be raising its long-run inflation objective, and so its commitment to stabilizing inflation would remain as strong as ever.

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 during normal times, 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 policymakers need to not only focus on the modal outcomes, as they would in a certainty equivalent world which is a feature of the linear-quadratic framework, but they also have to tailor their policies to cope with uncertainty and 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 argues for a particular form of a 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 preemptively 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. By so doing, monetary policy can reduce the likelihood that a financial disruption might set off an adverse feedback loop. The resulting reduction in uncertainty can 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 this result most effectively, monetary policy would be timely, decisive, and flexible. First, *timely action* is crucial 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 needed. Therefore, monetary policy must be especially preemptive in responding to financial shocks. When financial markets are working well, monetary policy can respond primarily to the incoming flow of economic data about production, employment, and inflation. When a financial disruption occurs, however, greater consideration needs to be given to 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 are currently strong, monetary policy would act to offset the negative impact of the financial disruption.

Second, policymakers 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 be a significant risk of more severe adverse outcomes. In such circumstances, 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 in the central bank's assessment of the most likely outcome for the economy, but rather as an appropriate form of risk management that reduces the risk of particularly adverse outcomes.

Third, *policy flexibility* is crucial 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 recognize 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 optimal monetary policy would involve gradual changes in monetary policy. Instead aggressive actions by central banks to minimize macroeconomic risk would result in preemptive, 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 perecentage points) even though the economy was displaying substantial positive momentum with real GDP growth quite strong in the third quarter. The Fed was clearly not reacting to current economic conditions, but rather to the downside risks to the economy from the financial disruption. Subsequently, the Fed very rapidly brought the federal funds rate target from its level of 5 ¼% before the crisis to 2% from September 2007 to April 2008. Then after the Lehman Brothers collapse in September 2008, the Fed began another round of rapid interest rate cuts, with the federal funds rate target lowered by 75 basis points in December 2008, bring it down to the zero lower bound. Clearly, the Fed had abandoned gradualism.[30]

One danger from aggressive, preemptive 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 stabilizing economic activity and not enough on price stability. If this perception occurs, the preemptive actions might lead to an increase in inflation expectations. The flexibility to act preemptively against a financial disruption presumes that inflation expectations are well anchored and unlikely to rise during a period of temporary monetary easing. To work effectively, the risk management approach outlined here thus requires a commitment to a strong nominal anchor. A risk management approach therefore provides an

[30] One period before the crisis when the Fed abandoned gradualism was during the LTCM episode when the Fed lowered the federal funds rate target by 75 basis points in a month and a half period in the fall of 1998. This action fit into the risk management approach described here. However, once the shock dissipated, the Fed 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 Greenspan Fed. Not only did inflation subsequently rise above the desired level, but it also indicated that the Fed would react asymmetrically to shocks, lowering interest rates when a financial disruption occurs, but not raising them when the adverse shock reversed itself. This helped contribute to the belief in the "Greenspan put" that will be discussed below.

additional rationale for 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 to forestall an adverse feedback loop.

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 distinguishing between two different types of asset-price bubbles. We then see how this bears on the lean versus clean debate and then examine the case for different policies to respond to potential bubbles.

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 2007-2009 indicates 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: Because 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 the extreme, 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 fueled by a feedback loop between bank lending and rising equity values and so the bursting of the tech-stock bubble was not accompanied by a marked deterioration in bank balance sheets. The bursting of the tech-stock bubble thus did not have a very severe impact on the economy and the recession that followed was quite mild.

The Case for Leaning Versus Cleaning. We have learned from the recent crisis that the bursting of credit-driven bubbles not only can be extremely costly, but are 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, 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 afterwards has therefore become much stronger.

However, the distinction between the two types of bubbles, one which (credit-driven) is much more costly than the other, suggests that the lean versus clean debate may have been miscast, as White (2009) indicates. Rather than leaning against potential asset-price bubbles, which would include both credit-driven and irrational exuberance type bubbles, there is a much stronger case for leaning against credit bubbles which would involve leaning against credit-driven bubbles, but not irrational exuberance bubbles. As White (2009) and Mishkin (2010b) have pointed out, it is much easier to identify credit bubble than it is to identify asset-price bubbles. Financial regulators and central banks often have information that lenders have weakened their underwriting standards, that risk premiums 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.

Macroprudential Policies. Although there is a strong case to lean against credit bubbles, what policies will be most effective? First it is important to recognize that policies should be designed with an eye toward fixing market failures. Credit extension necessarily involves risk taking. It

is only when this risk taking is excessive because of market failures that credit bubbles are likely to develop. Recognizing that market failures are the problem, it is natural to look to prudential regulatory measures to constrain credit bubbles.

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

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

Macroprudential regulations would attempt 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.[31] It is important for research to continue to analyze the role of bank capital requirements in promoting financial stability, including whether capital requirements should be adjusted over the business cycle Other macroprudential 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 instititons.[32]

Some policies to address the risks to financial stability from asset price bubbles could be made a standard part of the regulatory system and would 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 to limit the market failures in such a case. For example, during certain periods risks across institutions

[31] For example, see Kashyap and Stein (2004), Goodhart (2008), Adrian and Shin (2009).
[32] For example, see Bank of England (2009), French et al. (2010)….

might become highly correlated, and there might be a need to pursue discretionary policy to respond to these higher-stress environments.

Monetary Policy. The fact that the low interest rate policies of the Federal Reserve from 2002 to 2005 was followed by excessive risk taking suggests to many that overly easy monetary policy might promote financial instability Using aggregate data, Taylor (2009) 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, suggests that there is a case for monetary policy to play a role in creating credit bubbles. Borio and Zhu (2008) have called this mechanism the "risk taking channel of monetary policy".

The literature provides two basic reasons why low interest rates might promote excessive risk taking. First, as Rajan (2005, 2006) points out, low interest rates can increase the incentives for asset managers in financial institutions to search for yield and hence increase risk taking. This incentives could come from contractual arrangements which 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 also could 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 behavioral considerations such as money illusion in which they 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 for how low interest rates could promote risk taking operates through income and valuation effects. Low interest rate increase net interest margins and increase the value of financial firm, increasing 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 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 a viewpoint of establishing credibility and a strong nominal anchor, more predictable monetary policy can reduce uncertainty and encourage asset managers to underestimate risk (Gambacota, 2009). Monetary policy which 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 headed the Fed, 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 risk-taking channel of monetary policy. Jimenez, Ongena, Peydro and Saurina (2009), using Spanish credit registry data, finds that low nominal interest rates, although they decrease 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 and find that lower U.S. federal funds rates increases lending to low quality borrowers that ends up with 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 for 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, predicts higher real GDP growth.

Given the support for the risk-taking channel, does this mean that monetary policy should 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, one instrument is being asked to do two jobs: 1) stabilize the financial sector and 2) stabilize the economy. Because there is another instrument to stabilize the financial sector, macroprudential supervision, wouldn't it be better to

use macroprudential supervision to deal with financial stability, leaving monetary policy to focus on price and output stability?

This argument would be quite strong if macroprudential policies were able to do the job. However, there are doubts on this score. Prudential supervision is subject to more political pressure than is monetary policy because it affects the bottom line of financial institutions more directly. Thus they will have greater incentives to lobby politicians to discourage macroprudential policies that would rein in credit bubbles. After all, it will be during a credit bubble that financial institutions will be making the most money and so have greater incentives and more resources to lobby politicians to prevent restrictive macroprudential policies. A case in point has been the recent Basel III accord. Press reports suggest that the capital standards in the accord was substantially weakened because of complaints by the German Landesbanken. Furthermore, implementation of the accord was put off for almost ten years, and the accord did not contain measures to deal with systemic risk considerations such as adjusting capital requirements over the credit cycle. The Basel III episode suggests that political considerations may make it extremely difficult to have effective macroprudential supervision.

The possibility that macroprudential policies may not be implemented sufficiently well to constrain credit bubbles, suggests that monetary policy may have to be used instead.[33] 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 on the risk-taking channel of monetary policy suggests that there is a stronger case 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 raise interest rates when a credit bubble looks like it is 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

[33] 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. They conduct simulations that show that were 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.

that it will occur. Furthermore, expectations that rates will rise with increased risk-taking means that interest rates will not have to be raised as much to have their intended effect.

Nonetheless, using monetary policy to lean against credit bubbles is not a monetary policy strategy that should 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 policymakers, and especially monetary policymakers, will need tools to assess whether credit bubbles are developing. Research is currently underway (e.g, as described in Adrian and Shin, 2010) to find measures will signal if credit bubbles are likely to be forming. High credit growth, increasing leverage, low risk spreads, and surveys to assess if credit underwriting standard are being eased are pieces of data that can help central banks decide if there is imminent danger of credit bubbles. Monitoring of credit market conditions will become an essential activity of central banks in the future and research on the best ways of doing so will have a high priority in the future.

This danger of thinking of 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, we are currently not in a situation of rapid credit growth, low risk premiums and increasing leverage. Indeed, we still seem to be mired in a deleveraging cycle that is producing serious headwinds for the economy. This doesn't mean that the situation couldn't change. However, at the current juncture, low interest rates do not appear

to be creating the next credit bubble and justification for raising them to curb risk taking is very weak.[34]

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 monetary and financial stability policy is a false one. As we have seen, monetary policy can affect financial stability, while macroprudential policies to promote financial stability will have an impact on monetary policy. If macroprudential 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 stabilize inflation and output. 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 macroprudential policies to ensure that a credit bubble does not get started. Coordination of monetary and macroprudential policies are required if 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 macroprudential policy provide another reason for having central banks take on the systemic regulator role. Coordination of monetary policy and macropudential policy can only be effective if one government agency is in charge of both. As anyone who has had the pleasure of experiencing the turf battles of different government agencies knows, coordination of policies is extremely difficult when control of these policies is housed in different entities.

VI.
Concluding Remarks

[34] Note that many emerging market economies are currently in a very different environment, with low U.S. interest rates a potential danger because the low rates may be promoting excessive risk taking. This suggests that policies could be directed at preventing credit bubbles from forming. The empirical research in Ioannidou et al (2009) is particularly relevant on this point.

The bad news is that we have just been through a once-in--hundred-year credit tsunami that has had a devastating impact on the economy 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, moreso.

The recent financial crisis, however, does require some major rethinking about the details of this basic framework for monetary policy strategy. We now recognize that the financial sector play a very prominent role in the macro economy and makes it highly nonlinear at times. This requires that we abandon the linear-quadratic framework for thinking about how to conduct monetary policy when there is a financial disruption. There is now a strong 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 stonger case for monetary policy to lean 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 it decisions to use monetary policy to restrict excessive risk are based on the correct information will be a high priority for research 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 come out of this crisis. The field of macro/monetary economics has become a hell of a lot 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.

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