Using Monetary Policy to Stabilize Economic Activity

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"Indeed, one of the first lessons one learns from studying a variety of hypothetical models is that the problem of economic stabilization is, even in principle, an extremely intricate one, and that a much more thorough investigation of both theoretical principles and empirical relationships would be needed before detailed policy recommendations could be justified." A. W. Phillips (1957, reprinted 1965, p. 677)

1. Overview

Following on the heels of 20 years of macroeconomic stability, the financial crisis that began in 2007, the ensuing steep decline in economic activity, and the perceived limitations of monetary policy once interest rates hit zero have forced a re-examination of the ability of central banks to stabilize the real economy. In contrast, just two years ago, many central bankers and academic monetary economists felt that advances in economic theory and applied policy analysis had put us to the point where, in Phillips' words quoted above, "detailed policy recommendations could be justified."

By the late 1990s, a broadly shared working consensus about monetary policy had developed, a consensus broadly shared by policymakers and academic economists (Goodfriend, 2007). Among the key aspects of this consensus were the role of price stability as the primary objective of monetary policy and the importance of credibility and transparency in terms of objectives and operating procedures. Many have given at least some credit for the period known as the Great Moderation to successful monetary policy, and certainly most discussions of monetary policy emphasized the dual objectives of stabilizing inflation around a low level and stabilizing some measure of real economic activity.[1] Financial stability was also mentioned as desirable, but by and large, discussions of monetary policy took financial stability for granted, and models used for policy analysis almost always assumed financial frictions were irrelevant for policy design.

This essay examines the role of monetary policy in stabilizing real economic activity. In the next section, I briefly review the consensus on monetary policy that developed over the past 20 years. This discussion sets the stage for an examination in Section 3 of monetary policy when the policy interest rate has fallen to zero. In Section 4 I assess issues relevant for post-crisis monetary policy, including the role of asset prices, the status of inflation targeting as best practice for central banks, and the pros and cons of price-level targeting. Conclusions are summarized in a final section.

2. The Consensus View

At the 2002 Jackson Hole Symposium, *Rethinking Stabilization Policy*, Svensson presented a paper titled "Monetary Policy and Real Stabilization" (Svensson, 2002). Svensson's essay provides a useful jumping-off point, as he summarized many of features of the consensus on monetary policy and provided prescriptions for implementing monetary policy aimed at achieving low and stable inflation while also minimizing fluctuations in the real economy. The policy framework he articulated is commonly known as *flexible inflation targeting*. The name reflected the primacy of inflation as the ultimate objective of monetary policy; the flexibility reflected the short-run tradeoff between inflation control and real economic stability that would make strict inflation targeting—an exclusive focus on stabilizing inflation—too costly to be desirable.

The framework that underpins most analysis of flexible inflation targeting combines the assumption of dynamic optimizing behavior by private agents with nominal rigidities (e.g., Clarida, Galí, and Gertler, 1999; Woodford, 2003; Galí and Gertler, 2007; Galí, 2008; see also Walsh, 2010, chapter 8). This model can be summarized by two relationships that represent first-order approximation to the general equilibrium conditions for the economy. The first, an expectational investment saving (IS) curve, is derived from the Euler condition for optimal consumption and is given by:

$$x_t = \mathrm{E}_t x_{t+1} - \left(\frac{1}{\sigma}\right)(i_t - \mathrm{E}_t \pi_{t+1} - r_t^n), \tag{1}$$

while the second, the new Keynesian Phillips curve, can be written as:

$$\pi_t - \pi^T = \beta E_t\ (\pi_{t+1} - \pi^T) + \kappa x_t + e_t. \tag{2}$$

In this formulation, x_t is a measure of the output gap, defined as output relative to potential; i_t is the policy interest rate; π_t is the inflation rate; and π^T is the central bank's inflation target. To allow for a non-zero, steady-state rate of inflation, (2) incorporates the assumption that firms index prices to the central bank's inflation target, a specification common in the empirical literature.[2] Both r_t^n, the equilibrium (natural) real interest rate, and e_t represent exogenous stochastic disturbances. In this formulation, r^n can arise due to shocks to aggregate productivity, consumer preferences, risk aversion, or fluctuations in fiscal policy. In (2), the cost shock e_t can arise from stochastic fluctuations in the wedge between the flexible-price output and potential output. Flexible-price output is stochastic but exogenous.

Building on this core structure, modern policy models have introduced a variety of extensions designed to allow the model to be taken to the data. State-of-the-art dynamic stochastic general equilibrium (DSGE) models estimated using Bayesian techniques are proliferating globally and being integrated into policy analysis (e.g., Smets and Wouters, 2003, 2007; Christiano, Eichenbaum, and Evans, 2005; Aldofson, et al. 2007). The expectational IS curve and the new Keynesian

Phillips curve are at the core of these models, and many policy insights have come from the simple structure provided by (1) and (2).

Because movements in output gaps and cost shocks reflect transitory fluctuations, the unconditional expectation of the output gap is zero. Equation (2) then implies that $\mathrm{E}(\square_t - \square^{\square}) = \square\mathrm{E}(\square_{t+1}\square\square^{\square})$, where E denotes the unconditional expectations operator. Ruling out explosive paths for inflation, this condition implies $\mathrm{E}\square = \square^{T}$. Finally, from the IS equation, $\mathrm{E}(i\text{-}\square) = \mathrm{E}r^{n}$. These results illustrate the core conclusions of the policy consensus: The unconditional expected real interest rate is exogenous to monetary policy and depends only on the behavior of real factors; monetary policy has no sustained impact on real economic activity; and average inflation has no inherent anchor but instead depends on the central bank's inflation target. Hence, monetary policy must provide a credible nominal anchor to ensure inflation remains low and stable.

The monetary transmission mechanism in this consensus model is quite simple. Because prices adjust sluggishly, the central bank can influence the real rate of interest through movements in its policy instrument i_t. By altering the real interest rate, aggregate spending is affected. Thus, monetary policy affects the real economy by altering the intertemporal price of output, causing private agents to substitute toward (if the real interest rate falls) or away (if the real interest rate rises) current spending. Monetary policy can effectively stabilize real output at potential in the face of fluctuations in r_t^n if it moves the policy rate so that the interest rate gap, defined as $i_t - \mathrm{E}_t\pi_{t+1} - r_t^n$, remains at zero.[3]

Equation (1) also implies that:

$$y_t = -\left(\frac{1}{\sigma}\right)\sum_{j=0}^{\infty}\mathrm{E}_t(i_{t+j} - \pi_{t+j+1} - r_{t+j}^n), \qquad (3)$$

illustrating that aggregate demand is affected by both current and expected future real interest rates. Woodford (2005b) has stressed the implications of (3) in concluding that, as far as the effects of monetary policy on real economic activity, very little matters other than expectations about future policy. This insight, that it is the future path of policy that matters, plays a major role in the assessments of alternative policy rules, lies at the heart of recommendations for greater transparency, and forms the basis for many of the recommended strategies for escaping from a liquidity trap when the current interest rate is at zero.

Equations (1) and (2) have proven tremendously useful in improving economists' understanding of the role of monetary policy and the importance of systematic policy behavior for ensuring that low and stable inflation can coexist with stable real economy growth. When combined with a description of policy in terms of a rule for setting the nominal interest rate or a specification of policy objectives, the resulting framework has been used to address an extensive range of policy questions.

An important point to note is that (3) potentially overstates the number of policy instruments the central bank can use, as central banks may lack the credibility to manipulate expectations about future policy in ways that would help achieve policy goals. At the same time, the framework leading to (3) is one in which credit is inessential and plays no role. While one can price a variety of assets in this model, any policy, such as open market operations in short-term government debt, long-term government debt, or non-government debt, will, according to (3), affect economic activity *only* to the degree it alters either the current policy rate or expectations about future policy rates.[4] Thus, if financial frictions are important and/or assets are imperfect substitutes so that open market operations in alternative types of debt instruments can affect relative rates of return, (3) may potentially understate the instruments available to a central bank.

3. The Zero Lower Bound (ZLB) Constraint

In response to the financial crisis, major central banks drastically lowered their policy interest rates, as shown in Chart 1 for the Federal Reserve, the European Central Bank (ECB), the Bank of England, and the Bank of Japan. Once the policy rate reaches zero, traditional open market operations that lead to an expansion of reserves cannot lower interest rates further; the economy is in a liquidity trap. The objective in cutting policy rates was to lower real interest rates and

Chart 1
Policy Rates of the U.S., the ECB, the Bank of England, and the Bank of Japan

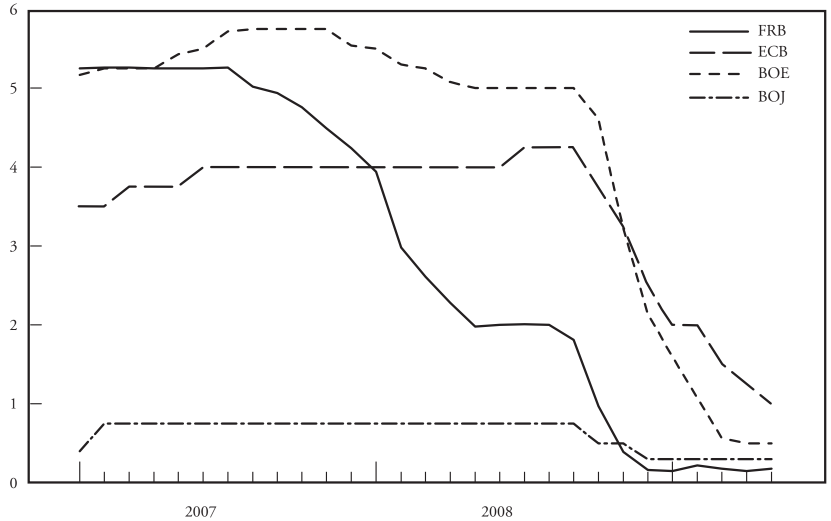
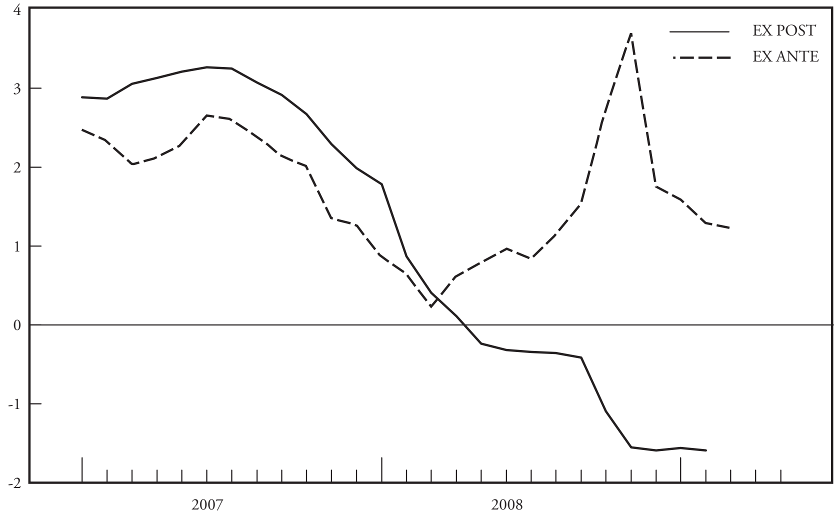


Chart 2
Ex-Post Real Interest Rate for the United States



Note: The ex-post real rate is measured as the federal funds rate minus the inflation rate (personal consumption expenditures less food and energy). The ex-ante real rate is the inflation-indexed 5-year Treasury rate.

boost aggregate spending. Chart 2 shows the ex-post real interest rate for the United States measured as the federal funds rate minus inflation, and the expected real rate, measured by the rate on inflation-indexed five-year Treasury securities. This ex-ante real rate rose through 2008 even as the funds rate was being aggressively cut.

Whether the ZLB actually limits the scope for monetary policy to stimulate the real economy is a matter of debate. In the remainder of this section, I discuss the extent to which the ZLB constrains monetary policy and some of the tools available to monetary policy at the ZLB.

3.1. Policy in the Face of the ZLB

Stabilizing the output gap in the face of shifts in the equilibrium real interest rate r_t^n requires that the central bank move its policy rate in tandem with r_t^n. At the same time, the Fisher relationship linking real and nominal interest rate and the ZLB on nominal interest rates requires:

$$i_t = r_t^n + E_t \pi_{t+1} \geq 0.$$

A decline in the economy's equilibrium, or natural, real rate of interest may be large enough to force nominal rates to zero. In this case, the ZLB prevents the nominal rate from falling sufficiently to ensure the actual real rate declines in line with the natural real rate. This is a fundamentals-based ZLB because it is driven by real factors that affect the equilibrium real interest rate.[5]

Faced with a fall in r_t^n and the possibility of the ZLB, both theoretical considerations and simulations using small-scale calibrated models and the FRB/U.S. model imply central banks should move aggressively to cut the policy rate.[6] This is true in forward-looking models under optimal commitment or discretion (Adams and Billi, 2006, 2007; Nakov, 2008). The need for aggressive responses to natural rate shocks is even more pronounced in models in which actual inflation depends on lagged inflation or in backward-looking models (Adams and Billi, 2007; Nishiyama, 2009). Thus, the available research does not support the idea that central banks should conserve their ammunition to avoid hitting the ZLB prematurely.

To see why an aggressive response is called for, write (1) as:

$$i_t = r_t^n + E_t\pi_{t+1} + \sigma(E_t x_{t+1} - x_t). \tag{4}$$

Ignoring cost shocks, optimal policy calls for keeping inflation equal to the target π^T and output equal to potential (the gap equal to zero) as long as the ZLB has not yet been reached. Thus, with $x_t = 0$ we can rewrite (4) as:

$$i_t = r_t^n + \pi^T + (E_t\pi_{t+1} - \pi^T) + \sigma\, E_t x_{t+1}.$$

The larger the negative shock to r^n, the greater the probability of the ZLB, so let $\gamma(r_t^n) > 0$ be the probability of hitting the ZLB the following period, with $\gamma' < 0$. Let $\pi^{zlb} < \pi^T$ and $x^{zlb} < 0$ be inflation and output at the ZLB. Then:

$$i_t = r_t^n + \pi^T + \gamma(r_t^n)[\pi^{zlb} - \pi^T + \sigma x^{zlb}] < r_t^n + \pi^T,$$

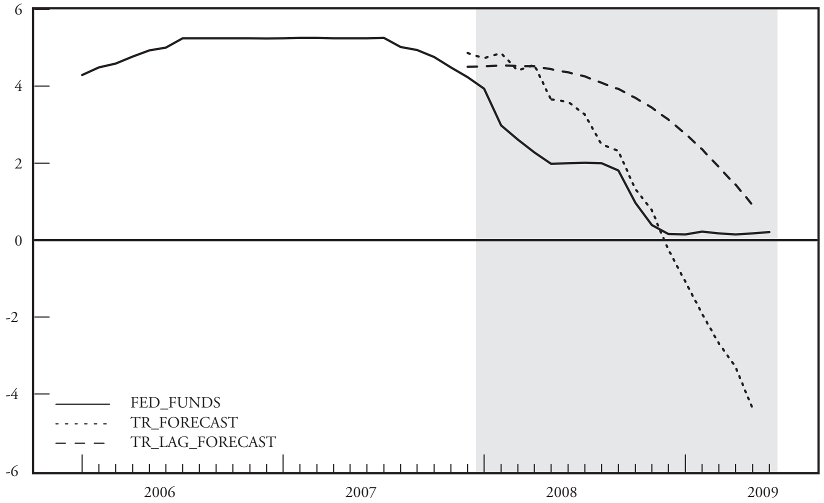
and

$$\frac{\partial i_t}{\partial r_t^n} = 1 + \gamma'(r_t^n)\left[\pi^{zlb} - \pi^T + \sigma x^{zlb}\right] > 1.$$

When the ZLB threatens, the policy rate is set lower than otherwise, and because the possibility of encountering the ZLB causes expectations of a future decline in output below potential and inflation below target, the optimal policy calls for a more aggressive interest rate cut in the face of a negative demand shock (a fall in r_t^n).

There is evidence that the Fed did respond quite aggressively in 2008, once it recognized the magnitude of the contractionary shock the economy had experienced. Chart 3 shows the actual path of the federal funds rate since 2006. Also shown are two alternative funds rate forecast paths for January 2008 through June 2009; these are based on variants of Taylor rules that include inflation (measured by core personal consumption expenditures, or PCE) and the unemployment rate gap estimated using monthly data from 1987 until December 2007.[7] The dotted line uses the response coefficients and the actual subsequent path of inflation and the unemployment gap to predict the path of the funds rate. The dashed line is the predicted funds rate using a Taylor rule augmented by included the lagged funds rate. As is clear, assuming inertial behavior by including the

Chart 3
Actual Path of the Federal Funds Rate Since 2006



Note: The solid line is the effective federal funds rate. The dashed line is the forecast from a Taylor rule that includes the lagged policy rate, while the dotted line is the forecast from a non-inertial Taylor rule.

lagged funds rate fails to capture the aggressive policy response of the Fed. The inertia rule predicted the funds rate would have still been around 3% when the actual rate had fallen to 25 basis points. In contrast, the simple Taylor rule fails initially to fall as quickly as the actual funds rate, but eventually falls to zero at the same time as the actual rate.[8]

The knowledge that the central bank will react aggressively prior to reaching the ZLB—a preemptive strike against the threat of a liquidity trap—can help reduce the probability that interest rates actually fall to zero. A failure to act preemptively would cause the public to expect a larger future economic downturn and decline in inflation. Such movements in expectations would force even larger interest rate cuts and push the economy to the ZLB even sooner.

An argument against an aggressive response is that it might actually cause a worsening of expectations about the state of the economy. This is a possibility when information is imperfect and asymmetric so that policy actions may signal something about the central bank's outlook for the economy. An aggressive cut in the policy rate may lead the public to revise downward their expectations about the state of the economy in the belief that the central bank must think the outlook is worse than previously thought. In this case, rather than promoting expectations of a future expansion, public expectations might deteriorate, worsening the contraction in economic activity (see Walsh, 2007).

3.2. Promising higher inflation

Cutting the overnight policy rate to stimulate real economic activity is clearly no longer feasible once the ZLB has been reached. However, it does not follow that the ZLB represents a serious constraint on monetary policy. In fact, most work suggests that the costs of the ZLB are quite small if the central bank enjoys a high level of credibility (e.g., Eggertsson and Woodford, 2003; Adams and Billi, 2006; Nakov, 2008). The key insight is that the central bank has more policy instruments than just the current level of the policy interest rate—it can also affect expectations of future policy.[9]

At the ZLB, (3) implies the current output gap is equal to:

$$x_t = \left(\frac{1}{\sigma}\right) \mathrm{E}_t \pi_{t+1} - \left(\frac{1}{\sigma}\right) \sum_{j=1}^{\infty} \mathrm{E}_t (i_{t+j} - \pi_{t+j+1}) + \left(\frac{1}{\sigma}\right) \sum_{j=0}^{\infty} \mathrm{E}_t r_{t+j}^n . \tag{5}$$

Thus, output can be stimulated by raising expected inflation, by lowering expected future real interest rates, or by raising the natural real rate, either now or in the future. If the central bank is able to commit to future policies, it can stimulate current output by committing to a lower future path for i_{t+j}. In particular, this would involve keeping the policy rate at zero even when the natural rate has risen to levels that would normally call for the policy rate to move back into positive territory. That is, the central bank commits to maintaining a zero-rate policy even when the ZLB is no longer a binding constraint (Eggertsson and Woodford, 2003).

While (5) is based on the forward-looking IS curve, the forward-looking Phillips curve given by (2) implies a second channel through which output can be stimulated at the ZLB. By committing to reduce future real interest rates, the central bank is committing to generating an economic boom once the economy is out of the liquidity trap. This boom will generate higher inflation in the future, leading to a rise in expected future inflation. This acts to raise current inflation, lowering the current real rate of interest.

The finding that optimal policy involves committing to lower interest rates in the future is consistent with the strategies proposed for Japan when it faced the ZLB. For example, Krugman (1998), McCallum (2000), Svensson (2001, 2003), and Auerbach and Obstfeld (2005) all proposed that the Bank of Japan commit to policies that would promise future inflation. Raising inflation expectations and committing to reducing the policy interest rate in the future are not separate policy options. It is by committing to lower future policy rates that the central bank affects future inflation at the ZLB. It is not surprising that much of the criticism the Bank of Japan received for its conduct of policy earlier this decade centered on its unwillingness to commit to higher inflation and its decision to raise interest rates above zero prematurely (see, for example, the discussion by Ito, 2004, or Hutchison and Westermann, 2006, chapter 1). After instituting a zero-interest-rate policy (ZIRP) in February 1999, the Bank of Japan lifted rates in March 2000, despite weakness in the economy and while inflation was still negative.

Eggertsson and Woodford (2003) demonstrate that the optimal commitment to future inflation can be implemented by targeting a price-level path that is adjusted for past shortfalls from the target path.[10] They also show that a simple, constant price-level target also does well at alleviating the costs of the ZLB. Price-level targeting is discussed more fully in Section 4.4.

Promising future inflation while at the ZLB raises a critical difficulty: Central banks may lack the credibility to make such promises. Bernanke, Reinhart, and Sack (2004) conclude, based on a study of market reactions to speeches by Federal Reserve governors, that it is possible to affect expectations about the future path of the policy rate. However, even central banks such as the Fed, the ECB, and many inflation targeters that had developed high levels of credibility prior to the current crisis may find it difficult to steer future expectations in a ZLB environment in which they lack a track record.

In fact, rather than promising future inflation, policymakers seem to be concerned that expectations of future inflation remain anchored.[11] In testimony before the House Committee on Financial Services in July, Federal Reserve Chairman Bernanke stressed that the Fed would prevent a rise in inflation as the economy recovers from the current recession, stating "...that it is important to assure the public and the markets that the extraordinary policy measures we have taken in response to the financial crisis and the recession can be withdrawn in a smooth and timely manner as needed, thereby avoiding the risk that policy stimulus could lead to a future rise in inflation."

Mishkin (2009) is explicit in arguing that even in a financial crisis it is imperative to keep inflation expectations anchored. While a decline in inflation expectations at the ZLB would boost real interest rates and worsen the downturn, a rise in inflation expectations would, as Mishkin notes, significantly affect future inflation and could be counterproductive. And commitment policies require that any promise to inflate in the future must be carried out; failing to do so would remove the possibility of influencing expectations if the ZLB were encountered again in the future.

If the central bank lacks the high degree of credibility implicit in the optimal commitment solution or is unwilling to let inflation expectations rise, the ZLB does pose a serious constraint on stimulating the economy. And when policy is conducted in a discretionary environment in which the central bank cannot affect expectations directly, the costs of the ZLB rise markedly.[12]

Current Federal Reserve policy seems to be inconsistent with the recommendation of the consensus model for optimal policy at the ZLB. At present, the Fed is simultaneously promising to keep interest rates low for an extended period while also promising to prevent inflation from rising. Keeping interest rates low when the equilibrium real interest rate returns to more normal levels will fuel an economic boom and generate higher future inflation. In fact, the point of committing to low rates in the future is precisely because this will generate expectations of inflation. While it may be that the required inflation is moderate, it is inconsistent to commit to low interest rates and stable inflation.

While central banks may lack the ability to steer future expectations in the ways called for under optimal policy, they might still be able to influence expectations of future inflation by publicly raising the inflation target. This may represent a more credible commitment to higher future inflation, particularly for inflation targeters, than any promise to keep the policy rate at zero for an extended period of time. However, it is not clear how pricing decisions actually depend on the announced target. The type of indexation to the target implicit in (2) is inconsistent with the micro evidence, though as mentioned previously, all empirical DSGE policy models assume a form of indexation, often to a weighted average of the target and past inflation. Yet the view that future inflation requires committing to lower interest rates in the future to create a boom reflects a view that inflation is ultimately a reflection of imbalance between supply and demand in the goods market and not solely a monetary phenomena.[13] Raising the target may also lack full credibility, as there would not be any change in a policy instrument that the public could observe.

If (3) fully captures the monetary policy transmission mechanism, monetary policy can only stabilize the real economy at the ZLB by affecting expectations of the future path of the policy interest rate. While reliance on the Euler condition for optimal intertemporal consumption is common in theoretical models, policy discussions normally focus on the role of long-term interest rates in affecting aggregate spending. Standard models of the term structure imply the m-period zero-coupon bond rate is related to the expected future path of the short-term real rate according to:

$$r_t^m = \left(\frac{1}{m-1}\right) \mathrm{E}_t \sum_{j=0}^{m-1} \left(i_{t+i} - \pi_{t+i}\right) + \Psi_{m,t}, \tag{6}$$

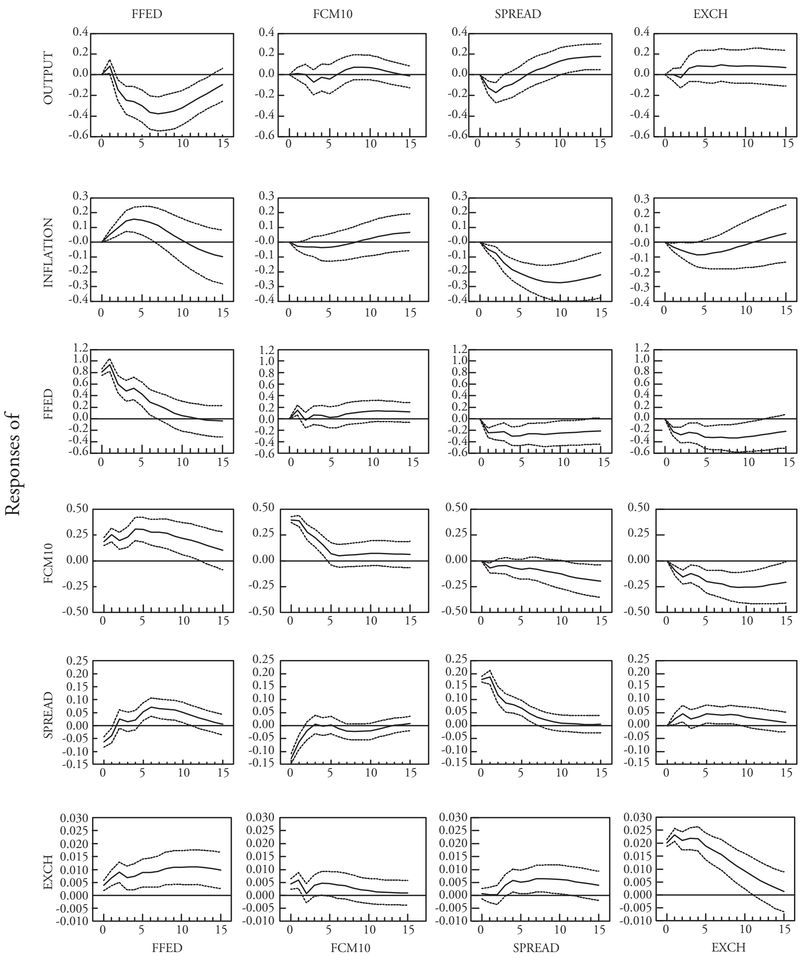
where $\Psi_{m,t}$ is a risk premium. When $\Psi_{m,t}$ is viewed as exogenous, (6) implies, as did (3), that only by influencing expectations about future interest rates and inflation can the central bank affect the real economy at the ZLB. If $\Psi_{m,t}$ is endogenous and varies with factors influenced by monetary policy, then altering the path of the future policy rate may not be the sole means of affecting the economy at the ZLB. The following section considers whether there are other transmission channels besides the expected future path of interest rates that might provide the means to stabilize the real economy at the ZLB.

3.3. The monetary transmission process

Basic frameworks for monetary policy emphasize the intertemporal price of consumption and the real cost of borrowing as key channels through which policy affects real economic activity. In an open economy, the relative price of domestic and foreign production also plays a key role. Financial factors are largely ignored. Credit markets do not operate frictionlessly, however; they provide important intermediation services that help alleviate problems of asymmetric information and costly contract enforcement. Disruptions to these markets, as we have seen over the past two years, can generate severe recessions, and in normal times, these markets contribute to the ways in which policy actions affect the real economy. In terms of (6), financial frictions may lead $\Psi_{m,t}$ to vary systematically with real interest rates, potentially amplifying the effects of policy actions, or $\Psi_{m,t}$ may be affected directly by actions of the central bank.

The basic channels of monetary policy are illustrated in Chart 4, which shows impulse responses from a value at risk (VAR) estimated over the 1974:1-2007:4 period using quarterly U.S. data. The VAR includes a measure of the output gap (log real GDP minus the log of the Congressional Budget Office, CBO, estimate of potential GDP), inflation (PCE less food and energy), the funds rate, the 10-year Treasury rate (FCM10), the spread between the Baa corporate bond rate and the 10-year Treasury rate, and the exchange rate (log trade-weighted real exchange rate).[14] To make the chart easier to read, the responses to output and inflation shocks are not shown. The standard output decline and inflation price puzzle phenomenon are seen in response to a funds rate shock (column 1). The rise in the funds rate leads to an increase in the long-term rate, but the spread on corporate bonds over the 10-year rate falls initially before rising. Finally, the dollar appreciates. Innovations to the credit spread variable (column 3) lead to declines in both output and inflation, indicating that these shocks primarily act as aggregate demand shocks. In response, the funds rate falls. Finally, an innovation to the exchange rate (an

Chart 4
Impulse Responses to a Funds Rate, 10-year Rate, Spread, and Exchange Rate Shocks: 1974:1-2007:4



appreciation, column 4) has little effect on output but does lead to a decline in inflation and interest rates.

If the policy rate is at zero, are there ways the central bank can directly depreciate the currency as a means of generating inflation that would lower the real rate of interest? Or can it affect credit markets to reduce credit spreads as a means of stimulating the economy?

- **The exchange rate channel**

For many economies, the exchange rate channel represents the primary way policy affects real economic activity and inflation. In the face of a contractionary demand shock, interest rate cuts should cause a currency depreciation that serves to expand demand for domestic production, and expanding the money supply can depreciate the currency even at the ZLB. A depreciation was central to proposals by McCallum (2000) and Svensson (2001, 2003) that, in a liquidity trap, the central bank should engage in unsterilized foreign exchange interventions to lower the value of the currency. Svensson's recommended policy combined a depreciation of the domestic currency with a commitment to a trending price-level target. Once the price-level target was achieved, Svensson recommended a return to inflation targeting.

In the case of a single country caught in a liquidity trap, as was the situation faced earlier by Japan, a depreciation is feasible. The current situation of zero nominal interest rates is not equivalent. In a global crises, *all* countries cannot depreciate.[15] Policies that rely on real exchange rate movements do not provide promising avenues for lifting all countries out of the current recession. And with all countries cutting interest rates to support domestic demand, the impact on the exchange rate will be driven by shifts in risk preferences and flights to quality. For example, in the current crisis, the U.S. dollar initially fell in value as the Fed cut the federal funds rate, the result expected from the VAR results. But the dollar then appreciated by 20% between April 2008 and March 2009, the period over which the federal funds rate fell from just under 3% to essentially zero.

- **Liquidity, portfolio balance effects, and financial market frictions**

Models in which financial markets play a significant role generally focus on channels that involve liquidity effects, imperfect asset substitutability, agency costs, and/or credit constraints.

- **Liquidity**

Financial institutions create liquidity by issuing short-term liabilities backed by long-term, less-liquid assets. This creates the possibility that solvent institutions will face liquidity shortages, and real economic stability is promoted by the existence of a lender of last resort. This role for central banks has long been understood, and the current crisis has seen an expansion in both the range of institutions allowed access to central bank liquidity and the types of collateral that can be pledged on borrowing from the central bank (Cecchetti, 2008). However, the situation in 2007-2009 appeared more similar to the collapse of markets due to severe problems arising from asymmetric information—a lemons problem in which markets fail to function (Alkerlof, 1970)—than it did to a classic bank run (Diamond and Dybvig, 1983). In the latter case, the assets backing short-term deposits are sound. In the lemons case, it isn't clear what the value of assets might be, nor is it obvious that the institutions are solvent. This possibility raises important issues for central banks, particularly concerning the acquisition of new types of assets as the result of non-conventional open market operations.

- **Imperfect asset substitution**

During the monetarists-Keynesian debates of the 1960s, both sides of the debate took the view that financial and real assets were imperfect substitutions. Both sides emphasized that shifts in portfolio composition generated by open market operations required adjustments in relative returns and asset prices to restore equilibrium. (Meltzer, 1995; Tobin, 1969; Goodfriend, 2000). Disagreement focused on the range of assets that were potential substitutes for money holding in private portfolios. Monetarists emphasized that the process of portfolio rebalancing could affect real asset holdings, not just financial holdings (see Meltzer, 1995). Thus, the reduction in the liquidity yield of money that occurs when its quantity is increased causes a substitute into both financial and real assets. Because the private sector must, ultimately, hold the larger stock of money, this attempt at rebalancing portfolios raises the prices of both financial and real assets, creating incentives for capital goods producers to expand production.

To illustrate the role of open market operations, consider the nominal budget constraint of a household holding money plus short-term government debt, denoted by B yielding nominal return i^b:

$$P_tY_t + \left(1+i_t^b\right)B_t + M_t \geq P_tC_t + P_tT_t + B_{t+1} + M_{t+1}.$$

Y is real income, C is real consumption, and T denotes real taxes. Letting lower case variables denote the real values of the nominal variables, and r denote the real return, the budget constraint can be expressed in real terms as:

$$Y_t + \left(1+r_t^b\right)F_t \geq C_t + T_t + \left(\frac{i_t^b}{1+\pi_t}\right)m_t + F_{t+1},$$

where $F_t \equiv b_t + m_t$ equals real holds of financial assets. If the nominal interest is zero, $1 + r^b = 1/(1 + \pi)$, and the budget constraint becomes:

$$Y_t + \left(\frac{1}{1+\pi_t}\right)F_t \geq C_t + T_t + F_{t+1}. \qquad (7)$$

Money drops out. At the ZLB, short-term riskless securities and money are perfect substitutes, so a substitution of money for government debt does not require the public to rebalance their portfolios. This is the essence of a liquidity trap.

As emphasized by Auerbach and Obstfeld (2005), this standard result overlooks two aspects. First, intertemporal models imply that the price level today depends on the expected future value of money. As long as nominal interest rates are expected to be positive in the future, prices in the future will depend on the future supply of money. An increase in the money supply now that is anticipated to be permanent will raise both expected future prices and current prices. The fact that short-term government debt and money are perfect substitutes at the ZLB does not mean open market operations have no effect. A quantitative easing policy that leads to an expansion of the money supply at the ZLB will affect the economy, as long as the rise in the money supply is expected to persist (Sellon, 2003).

The second aspect of an open market operation at the ZLB is that as long as nominal interest rates are expected to be positive at some point in the future, purchases of short-term government debt by the central bank alters the consolidated government's intertemporal budget constraint. The substitution of noninterest-bearing liabilities for interest-bearing liabilities lowers the present value of government revenues needs. This implies that taxes must fall, either now or in the future, to maintain budget balance. Auerbach and Obstfeld (2005) showed that these fiscal effects can have a significant impact on nominal income at the ZLB. When prices are sticky, this rise in nominal income takes the form of an expansion in real output.

Suppose government debt consists of short-term and long-term debt. If long-term debt and money are imperfect substitutes when the interest rate on short-term debt is zero, open market operations that involve purchases or sales of long-term debt will require changes in relative rates of return consistent with private sector demands for the two financial assets. Such an open market purchase would reduce long-term debt held by the public and lower its return. This process would also reduce returns on assets that are close substitutes for long-term government debt and raise them on those assets that are close substitutes for short-term government debt. And, as with open market operations in standard short-term debt, changes in the composition of government debt will have fiscal implications (Auerbach and Obstfeld, 2005).

As noted by Clouse, et al. (2003), such an operation is equivalent to a standard open market purchase of short-term debt for money plus a purchase of long-term debt financed by a sale of central bank holdings of short-term government debt—in effect, an operation that twists the maturity structure of privately held government debt.

Whether such debt management operations are effective is an empirical issue. Prior to the current crisis, many argued that it would require extremely large open market operations in non-standard assets to have a significant impact on yields (e.g., Clouse, et al., 2003). This is an empirical question, and unfortunately, there is little evidence to go by. Bernanke, Reinhart, and Sack (2004) offer one of the most extensive attempts to employ effect studies and term structure models to determine if non-standard central bank open market operations have affected yields. Their general conclusion is that shifts in relative asset supplies, or the expectations of such shifts, do affect yields. However, it is not clear from their analysis whether these shifts lead to the sustained movements in relative yields that would be needed to successfully stabilize real economic activity.

Spiegel (2006) summarizes some of the evidence on the impact of purchases of long-term government bonds by the Bank of Japan. The evidence seems mixed, particularly so considering the Bank of Japan was simultaneously engaged in quantitative easing policies that expanded bank reserves. Spiegel concludes that the two policies did lower long-term interest rates, but that it is difficult to determine which policy was most effective. The policies may also have lowered rates by signalling the Bank of Japan's willingness to maintain its ZIRP.

In March 2009, the Federal Reserve began purchasing long-term U.S. debt, and its holdings as of July 29, 2009, had reached $224 billion. Since these purchases began, yields on 10-year constant-maturity Treasuries have risen 90 basis points, not fallen. It is worth noting that over 2007 and 2008, the maturity structure of U.S. government debt shortened significantly, as debt with maturity less than one year increased by more than $1.5 trillion, while debt with maturity over 10 years rose by only $58 billion. These Treasury operations may have overwhelmed the impact of Fed purchases. The net increase in the supply of short-term debt relative to long-term debt seems to have had little effect in lowering long-term rates.

If purchases of long-term debt are effective in stimulating aggregate demand, there remains the question of why they should be carried out by the central bank. These operations shorten the maturity structure of the Treasury's outstanding debt. The Treasury can alter the composition of its outstanding publicly held debt; there is no reason this should be done by the central bank. Holding long-term debt on its balance sheet exposes the central bank to losses when interest rates eventually rise. Goodfriend (2000) discusses how this necessitates greater coordination between the central bank and the fiscal authority and stresses the need for a Treasury guarantee against such losses. Clouse, et al. (2003) also consider this issue.

Finally, the central bank could conduct open market operations in private sector credit instruments. Clouse, et al. (2003) note that such actions would put the central bank in the position of evaluating credit risk and affecting the allocation of credit across borrowers in the private sector. Relative to open market operations in government debt, the supply of private credit instruments is not exogenous; central bank purchases that raised the price of such instruments and lowered their return would in all likelihood induce an expansion of issues by the private sector. In fact, the real effects of such operations would in part rest on the transference of risk from the private sector to the central bank. However, contract enforcement may be a smaller problem for central bank-intermediated debt, thereby reducing borrowing limitations that would otherwise constrain private sector borrowing (see Gertler and Karadi, 2009).

- **Agency and finance premium effects**

Bernanke and Gertler (1989, 1995) have argued that credit channels play an important role in the monetary policy transmission mechanism. Asymmetric information between borrowers and lenders can generate a wedge between lending rates and the opportunity cost of funds; this wedge is affected by balance sheet considerations and asset prices. With asset prices and cash flows moving procyclically, agency costs fall in booms and rise in downturns. Thus, a recession that weakens balance sheets also increases credit spreads, amplifying the effects of the original source of the cyclical movement.[16] In normal times, therefore, balance sheet effects may be an important channel through which monetary policy actions affect the real economy.

A rapidly growing literature is exploring the implications of agency costs and financial frictions for monetary policy based on the Bernanke, Gertler, and Gilchrist (1999) model. This work has involved both small-scale calibrated models and estimated DSGE models (e.g., Christiano, Motto, and Rostagne, 2007; Faia and Monacelli, 2007; Cúrdia and Woodford, 2008; Dib, et al., 2008; Demirel, 2009; and De Fiore and Tristani, 2009).

Most of the literature on agency costs has stressed the role the credit channel plays in the monetary transmission process. It has received less attention as a potential source of macroeconomic fluctuations, although exogenous shocks to this wedge play important roles in some models. Less attention has been devoted to understanding whether central banks can directly affect this wedge, particularly at the ZLB.

- **Collateral constraints and credit rationing effects**

Models of agency cost based on costly state verification can account for spreads between lending and borrowing rates, but the borrowing rates remain sufficient statistics for credit conditions facing borrowers. In the presence of credit rationing and borrowing constraints, interest rates are not sufficient to measure credit market conditions. The household's first-order conditions can be used to highlight the role of collateral constraints on borrowing. Assume households face constraints on borrowing but can use the value of their house as collateral. In this case, the standard linearized Euler condition given in (1) is modified to take the form:

$$x_t = \mathrm{E}_t x_{t+1} - \left(\frac{1}{\tilde{\sigma}}\right)\left(i_t - \mathrm{E}_t \pi_{t+1} - r_t^n\right) - \gamma_1 i_t - \gamma_2 \psi_t, \tag{8}$$

where ψ is the Lagrangian on the borrowing constraint (see Iacoviello, 2005; Monacelli, 2009). Policy actions that relax collateral constraints (i.e., lower ψ_t) increase aggregate demand. Similarly, a tightening of borrowing constraints, for a given level of interest rates, acts as a contractionary demand shock and would call for a fall in i_t to offset movement in ψ_t. Liu, Wang, and Zha (2009) incorporate collateral constraints on borrowing by firms into an empirical DSGE model. However, in their model ψ_t shocks are efficient and do not call for offsetting monetary policy actions.

Central banks can effectively lower ψ_t by exchanging assets held by the public for securities in the central bank's portfolio that are more highly valued as collateral by the private sector. This would seem to require that risk be transferred from the private sector onto the books of the central bank (see Buiter, 2008).

3.3.1. Summary on the transmission process

What does this brief discussion of the transmission process suggest about the ability of monetary policy to stabilize the real economy at the ZLB? The lender-of-last-resort role of central banks has always been an explicit recognition of the potential fragility of financial systems, and the past two years have seen major expansions in the provision of liquidity to private markets. Standard open market operations continue to have fiscal implications at the ZLB, and these fiscal effects can help stimulate aggregate spending. The effectiveness of open market operations in long-term government debt or other assets depends on the degree to which assets are imperfect substitutions, and this is an issue that has long been debated. Changing the maturity structure of the government debt, as others have noted, has fiscal implications and may require close coordination between the central bank and the fiscal authority. Purchases of private assets can have real effects by essentially transferring risk from the private sector to the central bank.

Most of the recent research has focused on how financial frictions affect the impact of interest rate changes on the real economy. Fluctuations in credit spreads and borrowing constraints matter for aggregate spending, and monetary policy may be able to affect them directly. Ensuring markets function and providing liquidity can promote economic activity by reducing credit spreads and borrowing constraints. However, it is not clear whether this reflects the direct impact of policies, given private sector assessments of risk, or whether the willingness of central banks to extend liquidity calms markets, reduces perceptions of risk, and therefore leads to a fall in credit spreads. And our knowledge of the quantitative importance of unconventional open market operations and other potential policies is limited.

3.4. Exit strategies

As the global economy begins to recover, the unconventional tools central banks have employed will need to be scaled back. Facilities designed to supply liquidity in the face of private sector demands should automatically unwind as the demand for liquidity declines. In the United States, this is already occurring. As central banks exit from crisis mode, important questions revolve around the degree to which current policy, with its promise of an extended period of zero interest rates, is designed to serve as a commitment that will bind future policy actions and how exit strategies will be clearly conveyed to the public.

The growth in the Federal Reserve's balance sheet and the huge expansion in reserve balances at the Fed is unsustainable, absent a major jump in prices. However, while this surge in reserves is primarily a temporary response to the crisis, how these reserves are withdrawn, and even the extent to which they should be removed, depends on whether the increase was part of a strategy of reducing real interest rates by generating expectations of inflation. Under an optimal commitment policy, the central bank does commit to a higher future price level. Thus, not all of the increase in reserves would be removed. That is, there must be a commitment that at least some of the increase is permanent. As discussed earlier, the Federal Reserve does not appear to want inflation expectations to rise, and therefore all, or almost all, of the reserve expansion will need to be reversed.

In its recent report to the Congress (Board of Governors, 2009), the Fed emphasizes two policy tools it can employ to tighten policy as the U.S. economy recovers: raising the interest rate paid on reserves and open market sales. Payment of interest on reserves, begun in October 2008, allows the Fed to move to a channel system of interest rate control, a system successfully employed by the ECB and the central banks of Canada, New Zealand, and Australia. Under such a system, the central bank establishes standing facilities for lending at a penalty over the target for the policy rate and pays interest on reserves at a rate less than the policy rate target.[17]

To illustrate the basic operation of a channel system, assume T is the expected value of the bank's end-of-day balances, and let actual end-of-day balances be $T + \varepsilon$, where ε is a mean zero random variable with continuous distribution function $F(.)$ and standard deviation σ. For simplicity, assume ε/σ is a standard normal variable. The realization of ε reflects payment flows that occur after the interbank market closes. The representative bank chooses T to balance two costs. First, if it sets T too high, it is likely to end the day with a positive reserve balance that earns less than could have been obtained by lending in the interbank market. Second, if T is set too low, the bank may end the day with a negative balance and need to borrow from the central bank at the penalty rate. The bank will choose T to minimize the expected sum of these two costs, subject to the probability distribution of the stochastic process ε.

In this environment, if $\bar{T}$ is the supply of reserves, the equilibrium interbank rate is:

$$i = i^* - s\left[1 - 2F\left(-\frac{\bar{T}}{\sigma}\right)\right] = i^r + \left(i^b - i^r\right)F\left(-\frac{\bar{T}}{\sigma}\right). \quad (9)$$

If a reduction in financial market volatility is associated with a decline in σ, the central bank can reduce the level of reserves in line with the fall in σ while leaving the level of interest rates unaffected.

Note that the right side of (9) depends on three policy instruments: the interest rate paid on reserves, the interest rate charged on borrowings, and the level of reserves. This means that the interest rate paid on reserves alone is not a sufficient description of monetary policy.

The discussion of the Federal Reserve's exit strategy provided to the Congress does not mention using a target for the federal funds rate as a policy instrument. In principle, this target could be dropped in favor of the rate paid on reserves and the rate charged on borrowing (or equivalent, the size of the penalty). If that is the Federal Open Market Committee's intention, it will need to communicate the change clearly. Markets, and the public, appear to understand monetary policy decisions under a regime of targeting the funds rate. While a channel system may allow better control of the funds rate, there are potential pitfalls in using the rate paid on reserves as the main instrument and the focus of communications. Raising the target level of interest rates while holding the spread constant is equivalent to raising the rates paid on reserves and charged on borrowing, but the perception that borrowing costs for households and firms are going up while the Federal Reserve is rewarding banks with higher interest on reserves may be less politically supportable, as it highlights potential distributional effects of monetary policy.

Communications will also be a challenge when it comes time to raise interest rates. The optimal commitment policy requires that rates be keep low past the point at which the equilibrium real rate has risen above zero, thereby avoiding the mistake of the Bank of Japan in lifting rates too soon. However, once the policy rate is raised, it should be increased quickly (Nakov, 2008). That is, while the policy rate is kept at zero beyond the point at which the equilibrium real rate has risen to positive levels, the optimal path for the policy rate then rises sharply. In a simulation exercise based on the U.S. situation in 2003, Nakov (2008) finds that under the optimal commitment policy, the Federal Reserve would have held the federal funds rate at zero for about a year longer than it actually did, but then it should have raised rates very rapidly, much more so than it actually did.[18] The implication is that there is no support for raising rates at a gradual pace once the zero-rate policy is ended.

4. Future Policy Design

The financial crisis and recession of the past two years suggest the monetary policy frameworks of the past 15 years need to be re-examined. Should central banks respond to asset prices? Is inflation targeting still best practice? Do recent experiences suggest an alternative approach to policy, such as price-level targeting, would be desirable? In this section, I discuss some principles that should guide policymakers as they consider defining policy goals to promote economic stability. I then turn to the role of financial frictions in monetary policy design, the status of inflation targeting, and the advantages and disadvantages of price-level targeting.

4.1. Policy objectives

While monetary policy should stabilize the *level* of inflation, monetary policy should not be used to stabilize the *level* of real economic activity. Contributing to stabilizing real economic activity implies stabilizing a measure of the gap between output and some benchmark value.[19] Research over the past 10 years has provided new insight into the benchmark for real economic activity around which output should be stabilized. This work emphasizes the link between the frictions that lead monetary policy to have important real effects on the economy and the goals of policy that best serve to promote economic welfare. In principle, the objective of policy should be to stabilize inflation and the gap between output and the economy's efficient level of output.

At a conceptual level, this efficiency gap serves to alert policymakers that the ultimate objectives of stabilization policy depend on the distortions that characterize the economy.[20] Absent any distortions, as in standard real business cycle models, there is no rationale for using monetary policy to stabilize the real economy—strict inflation targeting would be optimal. In the baseline model outlined earlier, there were two distortions: sticky prices and imperfect competition. Their joint presence generates the welfare costs of fluctuations that justifies deviating from strict inflation targeting. Distortions, such as nominal rigidities, provide both the rationale for stabilization policies and the possibility for monetary policy to affect the real economy.

Empirical DSGE models for monetary policy analysis incorporate a number of distortions that force policymakers to make tradeoffs between inflation and output gap stabilization. These tradeoffs arise as a result of stochastic fluctuations in markups in the goods and labor markets.[21] While central bankers do not normally see it as their role to offset distortions arising from imperfect competition in product markets, that is exactly what modern policy models imply they should do. And they should do so because these markup distortions interact with the staggered adjustment of prices to generate economic inefficiencies.

This does not mean that using monetary policy to offset fluctuations in product market competition is the first-best policy. Ideally, a time varying fiscal tax/subsidy scheme would be a more appropriate policy. If such a policy were available, then monetary policy could focus solely on stabilizing inflation; strict inflation targeting would again be optimal.

This discussion suggests four questions that policymakers need to ask in considering whether a phenomena calls for a monetary policy response: 1) Does the phenomena create real economic distortions? 2) If it does, do these distortions interact with nominal rigidities and/or other distortions associated with inflation? 3) If it does, is there a better instrument than monetary policy for dealing with the distortion? 4) If there is, is this instrument actually dealing with the problem? These questions are useful for considering the role of financial stability as a monetary policy goal.

4.2. The role of asset prices and financial frictions

Financial frictions, which have generally been absent from the consensus model of monetary policy, affect both the monetary policy transmission process and generate distortions in the real economy. These distortions interact with nominal rigidities. Just as time-varying tax and subsidies may constitute a better tool for dealing with markup shocks, targeted and time-varying financial regulations are better instruments than monetary policy for mitigating many of the effects of these frictions. But if regulation fails to do so, central banks cannot ignore financial frictions and financial stability. Dealing with distortions involves operating in the world of the second best, and financial market disturbances may force central banks to make tradeoffs between their inflation and output objectives.

4.2.1. The pre-crisis consensus

The consensus view concerning the role of asset prices and monetary policy was articulated by Bernanke and Gertler in 2001: "Changes in asset prices should affect monetary policy only to the extent that they affect the central bank's forecast of inflation" (Bernanke and Gertler, 2001). Bernanke and Gertler indicated another situation in which asset prices might be relevant: If the equilibrium real interest rate were to be affected by financial market disturbances, then the policy interest rate would need to adjust to prevent these disturbances from affecting either inflation or the output gap.[22]

To make both these points in a slightly more formal manner, consider the problem of minimizing a loss function that is quadratic in inflation and the output gap, given the structure of the economy represented by (1) and (2). It is well known that optimal policy can be characterized by a targeting rule that takes the form[23]:

$$\pi_t + \left(\frac{\lambda}{\kappa}\right)(x_t - x_{t-1}) = 0.$$

If monetary policy affects the economy with a lag, optimal policy involves adjusting the policy instrument to ensure the expected value of this condition holds (Svensson and Woodford, 2005), or:

$$E_t\left[\pi_{t+i}+\left(\frac{\lambda}{\kappa}\right)(x_{t+i}-x_{t+i-1})\right]=0. \qquad (10)$$

Thus, the evolution of inflation and the output gap under an optimal policy is given by the joint solution to (1), (2), and (10). It follows that any variable z_t other than inflation and the output gap is relevant for optimal policy in only two circumstances. If, conditional on the past history of inflation and the output gap, z_t Granger causes either inflation or the output gap, then z_t can be useful in forecasting the variables that appear in the optimal targeting rule (10). Or, from (1), if, conditional on the past history of inflation and the output gap, z_t Granger causes the natural real rate of interest, then it is relevant for setting the policy instrument consistent with (10). These conditions apply to asset prices, but they also apply to any other variable the central bank might consider responding to.

The empirical research has not found consistent evidence for the value of financial variables in predicting inflation or output. Stock and Watson (2003, p. 822) conclude that "some asset prices have been useful predictors of inflation and/or output growth in some countries in some periods." Thus, while asset prices might in principle be among the macro variables that the central bank should respond to, in practice their lack of forecasting ability was viewed as rendering them largely irrelevant for monetary policy.

In practice, the Fed did seem to react to asset prices. Rigobon and Sack (2003) find that the Federal Reserve has reacted to stock market prices. Lansing (2008) finds that the (log) stock market index and its rate of change both enter significantly when added to a standard Taylor rule estimated over the Greenspan-Bernanke period. Similar results to Lansing's are shown in Table 1. Notice that according to the estimated rule, the Fed lowered the federal funds rate in response to higher stock prices.

4.2.2. Are asset prices only relevant if they aid forecasting?

Table 1
Estimated Taylor Rules

Sample period: 1987:01-2007:12

	$\square_t$	$\square_{t-1}$	u_t^{gap}	u_{t-1}^{gap}	ln sp_{t-1}	Δln sp_{t-1}	sp_{t-1}^{hp}	i_{t-1}	$\bar{R}^2$
1)	1.336 0.06		–1.927 0.08						0.81
2)	0.567 0.09		–2.074 0.06		-1.574 0.15	0.021 0.00			0.89
3)	0.049 0.02		–0.283 0.03		-0.220 0.04	0.004 0.00		0.880 0.01	0.99
4)		0.540 0.08		-2.107 0.06	-1.621 0.14	0.024 0.00			0.91
5)		0.045 0.03		-0.271 0.04	-0.218 0.05	0.004 0.00		0.882 0.02	0.99
6)		0.106 0.02		-0.194 0.03		0.005 0.00	-0.395 0.14	0.918 0.01	0.99

Note: Each regression also includes a constant term.

The issue of forecasting value is an empirical one. An alternative perspective is to ask whether the addition of stock prices to a simple policy rule of the Taylor variety would lead to improved outcomes as measured by inflation and output gap stability. That is, does responding to asset prices improve policy outcomes? The literature that has investigated this question has generally concluded that asset prices can safely be ignored. For example, Bernanke and Gertler (2001) evaluate policy rules in a model with financial frictions and find little value in responding to asset prices.

Unfortunately, most of the analysis that lies behind the consensus view assumes the objective is to stabilize inflation and the output gap. As noted above, this essentially assumes that financial variables are relevant only in their role as aids to forecasting. However, economic distortions generate the justification for stabilization policies, and this is certainly true of distortions in financial markets. So the presumption must be that the presence of financial frictions should also affect the objectives of the central bank if these distortions interact with the nominal rigidities that provide the rationale for the standard objectives of monetary policy. Measures of financial distortions would then appear directly in the targeting rule (10).

Several papers have shown that monetary policy should dampen volatility in credit spreads (e.g., Cúrdia and Woodford, 2008; De Fiore and Tristani, 2009). In these models, fluctuations in credit spreads reflect inefficiencies that reduce social welfare. Cúrdia and Woodford assume borrowing and lending must occur through a financial intermediary, and real resources are required to carry out this intermediation service. The credit spread fluctuates as a result of inefficient variations in the markup of lending rates over borrowing rates. In De Fiore and Tristani, (2009), credit spreads arise from agency costs and can fluctuate inefficiently, and optimal policy involves moving interest rates inversely with shocks to the credit spread. Demirel (2009) finds that frictions associate with monitoring costs in financial markets increase the weight that should be placed on stabilizing real economic activity relative to inflation.

Although the exact channels are model-dependent, fluctuations in credit spreads can affect both aggregate demand and aggregate supply. On the demand side, they act as an inefficient tax on investment; on the supply side, they affect firm borrowing costs and therefore marginal costs. Thus, a rise in the credit spread reduces aggregate demand and simultaneously increases inflation. This suggests that the appropriate policy response to a rise in credit spreads will be uncertain. The contractionary impact on demand would call for a more expansionary policy—an interest rate reduction could offset partially the implicit tax on investment spending—yet the inflationary effect on marginal costs would call for a tighter monetary policy. The impulse responses to the credit spread reported in Chart 4 suggest that shocks to the credit spread have primarily operated as aggregate demand shocks. Therefore, a rise in spreads would call for a cut in the policy rate.

Because credit spreads are directly observable and do not display trending behavior, estimating the benchmark for defining a credit spread gap may be a less difficult problem than in the case of stock prices. If the steady state credit spread is constant, fluctuations in spreads may provide some reflection of inefficiencies that monetary policy can help stabilize.

However, the way policy should respond to credit spreads to stabilize real economic activity is not always so clear. For example, in work by Faia and Monacelli (2007), variants of simple Taylor rules that allow for a reaction to the price of capital (the asset price in their model) are analyzed. They find that strict inflation stabilization is optimal. However, assuming the central bank responds moderately to inflation (a coefficient equal to 1.5) and does not respond to output (output is in the rule, not an output gap), welfare is improved if policy does respond to asset prices. But the response calls for cutting interest rates in response to a rise in asset prices. Intuitively, the reason for this response is that Faia and Monacelli assume productivity shocks are the source of fluctuations. In this case, financial frictions limit any increase in investment spending in the face of a positive productivity disturbance. This is inefficient, so monetary policy can improve outcomes by reducing the interest rate. This helps move the level of investment closer to the efficient level.

So far, the discussion has focused on the role of financial variables in non-bubble situations. A separate issue, and one actively debated during the past decade, is whether monetary policy should attempt to lean against asset price bubbles. Cecchetti, et al. (2000); Cecchetti, et al. (2003); and Borio and White (2003) have argued that central banks should. Yet the consensus view prior to the crisis was that policymakers were limited in their ability to identify bubbles, and even if they could identify a bubble, monetary policy was too blunt an instrument to deal with this problem (Bernanke and Gertler, 2001; Gertler, 2003; Bernanke, 2002a; Kohn, 2008).

There seems little doubt that the consequences of allowing the bubble in housing prices to continue was a serious policy mistake in the United States and many other countries. The oft-cited analogy that using monetary policy to deflate a bubble was like taking a pin to a balloon was seriously misguided. It failed to recognize that allowing a bubble to continue until it popped of its own accord allowed the misallocation of real resources to continue, resulting in an even larger collapse than would have occurred earlier. Even on a narrow mandate that ignored financial distortions, one could argue that the growth in U.S. construction employment was inconsistent with maintaining maximum sustainable employment.[24]

While monetary policy may, in general, be a blunt tool for dealing with an asset-price bubble, housing investment and house prices are in fact the chief channel through which the interest rate policy of the Federal Reserve affects real economic activity. The housing bubble was eventually popped by the Fed's tightening of policy beginning in 2004. Undoubtedly, future policymakers will be more willing to risk undertaking policies to deflate incipient bubbles, though the difficulty of identifying them with certainty will always remain.

4.2.3. Summary on financial frictions

Discussions of asset prices and financial frictions in the pre-crisis period focused too much on the effects of these frictions in affecting the transmission process (financial accelerator, etc.) and too little on them as independent sources of macro instability. There may also have been too much focus on asset prices with correspondingly too little attention paid to the real resource misalignments and misallocations that bubbles create. Monetary policy may also be a blunt instrument for dealing with asset-price bubbles, but allowing bubbles to continue and then to burst imposes a tremendous cost on the economy.

Modern economic theory emphasizes that what monetary policy can do and what it should do are interdependent. There seems to be little controversy over the statement that financial market frictions are relevant for understanding the transmission mechanism through which monetary policy affects the real economy. What is less frequently recognized is that the distortions in financial markets that generate real effects of monetary policy also imply that financial stability may require making tradeoffs with the goals of inflation stability and stability of real economic activity. Yet how financial distortions can be identified and how these distortions are affected by monetary policy raise a host of practical issues that central banks will need to address. While credit spreads may provide one measure of the type of inefficient fluctuations that would call for a policy response, we still do not fully understand the factors that generate movements in spreads, or the degree to which these movements reflect inefficient fluctuations that call for policy responses.

4.3. Inflation targeting revisited

Prior to the crisis, inflation targeting (IT) was widely accepted as best practice for central banks, and recent favorable reviews of IT include Rose (2007) and Walsh (2009). Despite the apparent success of IT in supporting low and stable inflation without generating the greater output volatility its critics had predicted, the crisis has raised new questions about the future of inflation targeting.

It seems unfair to blame IT for a crisis whose origins were in the United States, as the Federal Reserve is not a formal inflation targeter. If one views the financial crisis primarily as a negative aggregate demand shock causing both output and inflation to decline, then even a strict inflation targeter would respond with expansionary policies as it attempted to prevent the collapse of aggregate spending. The result that policy needs to neutralize the impact of movements in the natural real interest rate is not dependent on assuming any particular weight on real versus inflation goals in the central bank's objective function.

One case in which natural real rate shocks might be only partially neutralized arises if the central bank prefers to limit volatility in its policy interest rate. If it does, then the policy rate will generally be moved too little to prevent real rate shocks from affecting the real economy. However, the standard argument for reducing interest rate volatility is that it reflects a desire by policymakers to reduce financial market instability. Such a motive would certainly not support the argument that IT central banks are insensitive to financial markets. And, just as the standard description of IT assumes the central bank engages in flexible IT to avoid unnecessary volatility in real output, it is also appropriate under flexible IT to ensure that achieving tighter control over inflation does not generate excessive financial instability.

A more serious concern is that IT elevates one objective of monetary policy to prominence and causes IT central banks to focus too much, or even exclusively, on achieving the inflation target, even if this comes at the expense of other macro objectives (for example, see B. Friedman, 2004). As surveyed in Walsh (2009), the empirical evidence does not support this view, at least with respect to output volatility. IT countries have not experienced any cost in terms of greater real economic instability. While IT arose primarily as a means of avoiding the reoccurrence of high inflation, the objective of IT central banks is to maintain low and stable inflation. Thus, recessionary pressures on the real economy call for expansionary policy responses, just as inflationary pressures call for offsetting policy responses. And while the consensus view that monetary policy should only be concerned with inflation and output gap stability may have contributed to the financial crisis by ignoring financial distortions, this failure was not limited to IT central banks.

If IT as a conceptual framework for monetary policy does not limit the ability of a central bank to engage in policies designed to stabilize the real economy, could its implementation be improved to reduce the likelihood of future crises? This issue arises primarily because of the ZLB on interest rates. If current economic conditions are strongly influenced by expectations of the future, then the possibility that the ZLB may be revisited at some point in the future will need to be accounted for in designing policy, even when interest rates are positive.

One change to IT would be to increase the average targets. The lower the inflation target, the more likely the ZLB is encountered, a point first made by Summers (1991). Reifschneider and Williams (2000) estimated that the ZLB is encountered almost 10% of the time at a 1% inflation target, and this frequency falls as the target is raised. However, a more effective strategy may involve reducing the risks of another major negative shock to aggregate demand. Better financial market regulation, as well as a more active response of monetary policy to emerging financial imbalances, could lower the chances of again hitting the ZLB. The permanent distortionary costs of higher average inflation would need to be balanced against the low probability of another negative shock of the magnitude the global economy experienced in 2008. Clouse, et al. (2003) note that low inflation at the beginning of the 1953, 1956, and 1960 recessions in the United States did not pose a constraint on monetary policy. Interest rates were reduced, but the ZLB was not reached.

4.4. Price-level targeting versus inflation targeting

The constraint posed by the ZLB on the nominal policy interest rate has led to renewed interest in price-level targeting (PLT) as an alternative to IT. As discussed earlier, the optimal commitment policy at the ZLB can be implemented through a form of PLT. It did not correspond to strict price stability, however, because the price target is adjusted upward based on past cumulative shortfalls from the previous target. However, Eggertsson and Woodford (2003) show that using a constant price target yields macro outcomes that are close to optimal at the ZLB.

Svensson (1999) and Vestin (2006) were among the first to provide modern evaluations of PLT. Their analyses were not directly concerned with the ZLB but did serve to reverse previous beliefs that PLT would lead to excessive volatility in the real economy.[25]

An advantage of PLT is its ability to mimic an optimal commitment policy when the actual regime is one of discretion (Vestin, 2006). This improvement occurs even though inflation stability is the ultimate objective of the central bank. Knowledge that prices will return to a target level influences expected inflation in ways that help to stabilize current inflation when price-setting behavior is forward-looking.[26] This can be particularly important in a deflationary liquidity trap. As the actual price level falls, the gap widens between the actual price level and the path for prices implied by the target path. The more severe the deflation, the greater must be the subsequent inflation to return prices to their intended path. Thus, a credible commitment to PLT would cause expected inflation to rise, helping to boost nominal interest rates above the ZLB.

In a basic model such as that given by (1) and (2), PLT improves over discretion when an economy experiences an inflation shock, and PLT and IT perform equally well in the face of shifts in the equilibrium (natural) real rate of interest, as long as the ZLB is avoided. When the ZLB is binding, PLT ensures expectations of future inflation move in a stabilizing fashion. Table 2 summarizes the relative performance of IT and PLT for different macro shocks.

PLT can be combined with a trend or average rate of inflation so that the target path is given by:

$$p_t^T = p_0 + \pi^T t,$$

where π^T is the average rate of inflation and p_0 is the initial price level. This process for the target makes p_t^T a trend stationary variable

Table 2
Outcomes to Shocks Under Discretion

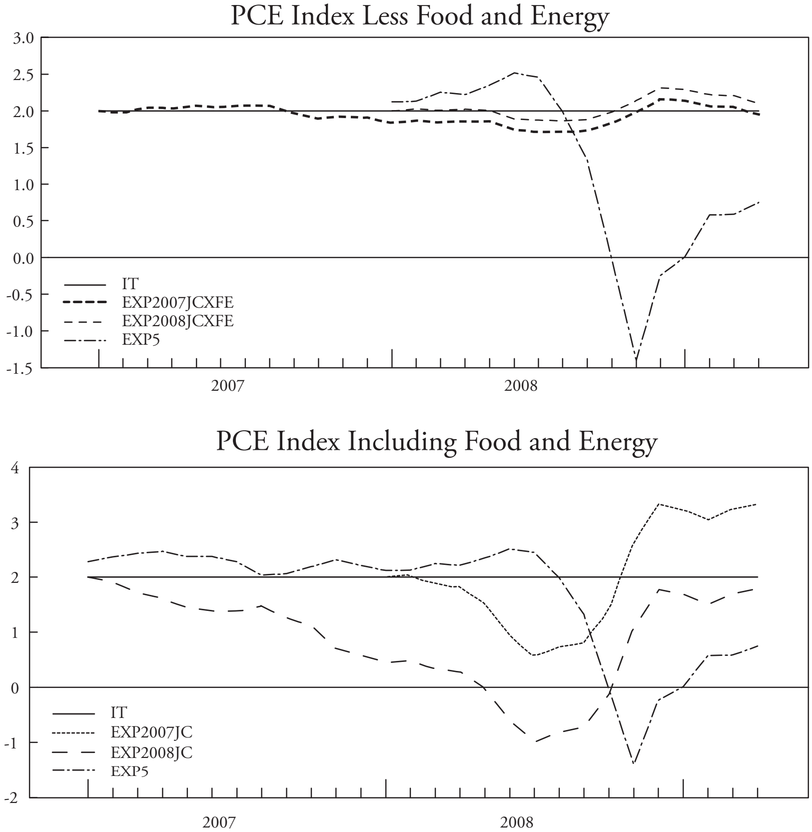
PLT relative to IT	
Disturbance	Price-level targeting
Inflation shocks	Better
Demand shocks, no ZLB	Same
Demand shocks, ZLB	Better

so that the subsequent inflation needed after a deviation of prices below the target level rises with π^T. A positive trend to the price path strengthens the way expectations act as an automatic stabilizer after deflationary shocks.

The effect on inflation expectations of adopting PLT will depend on when it is adopted and how quickly the public expects deviations from target to be eliminated. Chart 5 illustrates hypothetical paths for expected inflation under a PLT regime in the United States based on two different start dates: January 2007 and January 2008. In the top panel, the price level is assumed to be measured by the PCE index less food and energy, and the target path rises at a 2% annual rate. The bottom panel uses the PCE index including food and energy. For each adoption date, I assume a return to the target path takes four quarters. Also shown in each panel is a line at 2%, corresponding to inflation expectations anchored under an IT regime. Also shown is the expected inflation rate as implied by the indexed 5-year Treasury bond. In the top panel, the paths for expectations under PLT for both start dates fall slightly below 2% for part of the period, particularly in the first half of 2008. Because actually inflation in the United States has remained relatively stable, falling from October 2008 through January 2009 but then returning to levels similar to those seen in 2006 and 2007, the path of the actual price level has not diverged much from the hypothetical target paths. As a consequence, expectations would have remained close to the level of the inflation target.

Most IT central banks establish targets in terms of a consumer price index or headline inflation rate rather than the measure of core inflation employed to construct the top panel of Chart 5. The problems that can arise if a more volatile headline index is used are illustrated

Chart 5
Hypothetical Paths for Expected Inflation Under a PLT Regime in the United States



in the bottom panel of the chart. Because inflation rose above the assumed 2% target in 2007, a PLT policy would have required a deflation by early 2008. Of course, incorporating a higher trend inflation rate into the price path would shift the paths for expected inflation up. However, this would not change the conclusion that establishing a PLT in early 2007 would have initially produced a fall in expected inflation. Expectations would have moved in the wrong direction, exacerbating the ZLB problem.[27]

The hypothetical paths in the chart assume complete credibility of the PLT regime. Just as the adoption of IT did not produce immediate credibility, it is likely that any switch to PLT would involve gradual learning on the part of the public before the regime gained the level of credibility now enjoyed by IT. Kryvtsov, Shukayev, and Ueberfeldt (2008) show that the gains from imperfectly credible PLT in a calibrated model are fairly small, and the gains may not be sufficient to dominate IT if credibility is obtained slowly.[28] However, repeating this exercise using the Bank of Canada's policy model, "ToTEM," Cateau, et al. (2008) found the ultimate gains from PLT to be more significant.[29]

In general, the work on PLT may understate its advantages for two reasons. First, the analysis based on model simulations often ignores the ZLB, and a credible regime of PLT has advantages over IT at the ZLB. Second, models typically ignore an important financial friction: nominal debt contracts. While nominal interest rates can adjust to compensate for average inflation expected over the duration of a contract, PLT, by increasing the predictability of the future price level, can reduce risk premiums associated with nominal contracts. In a DSGE model estimated using Canadian data and including agency costs and nominally denominated debt, Dib, Mendicino, and Zhang (2008) find that PLT reduces the volatility of the real interest rate. This helps reduce distortions associated with nominal contracts.[30]

To summarize, PLT has advantages over IT by stabilizing the real interest rate, which can reduce financial frictions, and by ensuring inflation expectations act to help automatically stabilize inflation. This improves the tradeoff between output and inflation stabilization.

4.4.1. Should central banks adopt PLT at the ZLB?

PLT can contribute to better macroeconomic stability at the ZLB. Given this advantage over IT, should central banks adopt PLT?

It should be noted that PLT does not eliminate the possibility of a liquidity trap. For example, if monetary policy is implemented using a Taylor rule in which inflation deviations from target are replaced by price-level deviations from target, an expectational-driven liquidity trap is still possible.[31] However, when the economy is pushed into a liquidity trap as a result of a fall in the equilibrium real interest rate, PLT can help expectations act as an automatic stabilizer.

Despite this, there are several reasons for questioning the efficacy of adopting PLT when an economy is at the ZLB. First, the stabilizing adjustment of expectations arises only if the public understands the implications of PLT and believes the central bank is committed to this new policy. The experience with IT was that credibility followed experience and the gain in anchoring expectations was not something that was achieved immediately. Gaining credibility for PLT in the midst of a liquidity trap may be particularly challenging. The optimal time-varying price-level target path would be difficult to communicate to the public. This is a serious limitation because PLT's advantages arise from the way it allows expectations to be steered. While past commitment to a price- level target might aid in avoiding a ZLB or mitigating the impact of a ZLB situation, adopting a new, untested targeting regime while in a crisis seems inadvisable. In addition, at the ZLB, commitment to a price-level target would, to the extent to which it was successful in generating expectations of future inflation, lead to a rise in long-term real interest rates. This rise in long-term rates may easily lead some to question the central bank's commitment to economic expansion.

Second, the impact on expectations depends importantly on the speed with which the public expects the central bank to regain the target path. This may be hard for the public to forecast because there would be no past experience to draw upon. Similarly, it may be difficult for the central bank to assess the impact of the regime change on the public's expectations. If expectations are for an extended recession, the public may doubt whether the target path will be achieved very quickly. This would reduce the effect PLT would have in raising inflation expectations.

Third, commitment to a price path that involves future inflation is time-inconsistent. Recall that the price-level target is a means of implementing the optimal commitment policy, and this policy is itself time-inconsistent. Once the economy recovers from the ZLB, the optimal policy is not to create the inflation required to restore the price level to the promised target path.

Fourth, there is the question of which price index to target. Given the volatility of headline inflation, targeting the headline price index might generate destabilizing movements in expectations, as Chart 5 illustrated. Many critics of IT in open economies point to the problem of defining targets in terms of headline inflation. A depreciation then requires the central bank to contact domestic output to reduce inflation in domestic goods prices. This potential problem is even more severe with PLT.

Finally, optimal commitment means doing what you had previously promised to do, even if it is not the optimal thing to do at the moment. Many central banks have committed to IT. They have developed credibility by delivering low and stable inflation. The optimal strategy at the ZLB is to change the policy regime to one of PLT, and of course to promise never to change the policy framework again. Changing the policy regime in a crisis is exactly what discretion would call for.

5. Conclusions

There are several lessons from the crisis for the role monetary policy can play in contributing to stability in the real economy. Central banks need to respond aggressively to negative aggregate demand shocks that might push interest rates to zero, especial as the ZLB is a constraint on the ability of monetary policy to stabilize real economic activity when policymakers have limited ability to steer future expectations. Optimal policy calls for keeping interest rates low past the point at which the equilibrium real interest rate becomes positive, but once the policy rate is raised, it needs to be increased aggressively. Committing to a gradual increase in the policy rate is not justified.

A promise of future inflation can help boost the economy, but promises must be kept, and so central banks seem justifiably wary of committing to future inflation. However, current Federal Reserve policy, which seems to involve a commitment to keep interest rates low and to promise inflation will not rise, may not be consistent. The point of keeping interest rates low in the future is to promote economic activity today, but the price is a future rise in inflation. It is not clear how one has one without the other.

Standard open market operations at the ZLB can still affect current inflation and output if the resulting increases in reserves are seen to be permanent to at least some degree. Open market operations in long-term government debt have real effects to the extent assets are imperfect substitutes, but strong quantitative evidence on the effects of unconventional open market operations is lacking. These operations do have fiscal implications and so require coordination with the fiscal authorities. Since fiscal authorities can alter the maturity structure of the government's debt, it is not clear why the central bank should also attempt to do so.

Conclusions that monetary policy should not respond directly to financial market variables presumes that there is no fundamental role for financial distortions. Yet real distortions that interact with nominal rigidities are the rationale for having monetary policy be concerned with real economic stability and not just inflation stability. The presence of financial distortions calls for central banks to trade off some stability of inflation and real economic activity to ensure financial market stability.

Finally, PLT is a viable alternative to IT and is superior in terms of the way it is able to move expectations so that they serve as an automatic stabilizer. However, adopting PLT in a crisis seems inadvisable. The benefits of PLT rely heavily on its credibility, and the experience with IT suggests that credibility takes time to gain. And switching policy frameworks is the strategy of a discretionary policymaker, because optimal policy includes undertaking policies committed to in the past, even if they are not fully optimal at the moment.

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Endnotes

[1]See, for example, Svensson (2002).

[2]Indexation to some combination of the central bank's target and lagged inflation is a common assumption in estimated dynamic stochastic general equilibrium (DSGE) models, though the micro evidence finds no support for it. In the absence of indexation, the presence of a non-zero trend inflation rate has important implications for the linearized Phillips curve. See Ascari (2004), Coibion and Gorodnichenko (2008), and Sbordone (2007).

[3]As is well known, a policy that set $i_t = \pi^T + r_t^n$ would not ensure that $x_t = 0$ is the unique, rational expectations equilibrium.

[4]Eggertsson and Woodford show this formally (Eggertsson and Woodford, 2003).

[5]The ZLB may also represent an equilibrium to which the economy is driven by non-fundamental, expectational factors. Monetary economies possess multiple equilibria, and Benhabib, Schmidt-Grohe, and Uribe (2001) demonstrated that, when the central bank follows the Taylor principle, moving the policy rate more than one-for-one with inflation, an equilibrium exists in which deflation pushes the economy to the ZLB. This a non-fundamentals-based ZLB because it is driven by expectational factors not related to the equilibrium real interest rate. This does not seem to be relevant for the current situation.

[6]Adams and Billi (2006), Nakov (2008), Reifschneider and Williams (2000). See also Jung, Teranishi, and Watanabe (2005).

[7]The unemployment gap is equal to the monthly civilian unemployment rate minus an estimate of the natural rate of unemployment. The latter is obtained by fitting a smoothed Hodrick-Prescott filter to the Congressional Budget Office's quarter series on the non-accelerating inflation rate of unemployment and then using the filtered series to extapolate from quarterly to monthly values. This exercise draws on Rudebusch (2009).

[8]There has been a debate over the reason lagged policy rates are so significant in instrument rule regressions. Many interpret it as the result of interest smoothing or inertial behavior. Rudebusch (2006) has argued that the Fed does not engage in rate-smoothing behavior, an hypothesis that is borne out by the experience during 2008.

[9]Goodfriend (2000) discusses imposing a tax on money holdings as a means of avoiding the ZLB. Bryant (2000) discusses some of the pratical difficulties this would entail.

[10]That is, it involves an integral control (Phillips, 1965). Reifschneider and Williams (2000) find that an instrument rule that responds to cumulative target misses performs well in the face of the ZLB in the FRB/US model.

[11]This reluctance is discussed further in Section 4.4.

[12]See Adams and Billi (2007) and Nakov (2008).

[13]In standard monetary models with flexible prices, the value of money today depends on the expected present discounted value of the marginal utility of current and future monetary services. In a case-in-advance model, for example, the current price level depends on the expected future path of nominal interest rates. Thus, beliefs that interest rates will be higher in the future immediately raises the current price level. See Walsh (2010), chapter 3. This idea is developed in the context of an analysis of the liquidity trap by Auerbach and Obstfeld (2005).

[14]The sample start date is determined by the availability of the exchange rate series. The end date is chosen to exclude the recent financial crisis.

[15]Fujiwara, Sudo, and Teranishi (2009) analyze optimal policy in global liquidity crisis.

[16]Based on the VAR used for Chart 4, an negative output shock does initially cause the spread to increase.

[17]Such a system has been analyzed by Woodford (2001) and Whitesell (2006). See also Walsh (2010), chapter 11.

[18]See his Figure 14.

[19]This assumes the appropriate benchmark is independent of monetary policy. As Svensson (2002) notes, bad monetary policy might lower potential output, and there are various theoretical channels through which changes in average inflation could affect the level of potential output. The general consensus is that these channels are weak, so that to a first approximation, potential output is independent of average inflation. However, Berenstein, Menzio, and Wright (2008) offer evidence of a long-run relationship between inflation and unemployment.

[20]As a practice guide, an efficiency gap is unlikely to be very useful. Policymakers face enough trouble estimating trend output and standard output gaps in real time.

[21]Chari, Kehoe, and McGratten (2009) emphasize that there are alternative interpretations of these shocks that would not call for policy interventions.

[22]See also Kohn (2008).

[23]This describes optimal commitment policy from the timeless perspective.

[24]Between 2004:01 and 2006:06, employment in construction accounted for 20% of total employment growth, despite representing less than 6% of total employment.

[25]Coenan and Wieland (2004), McCallum (2000), Nakov (2008), and Wolman (2005) examine PLT in the context of a ZLB environment, using forward-looking models.

[26]Not surprising, therefore, Walsh (2003) found that PLT performed less satisfactorily in a discretionary environment when the inflation process displays inertia.

[27]Of course, this analysis ignores the fact that the price level might have evolved differently during 2007 and 2008 if the Federal Reserve had adopted PLT.

[28]They ignore the ZLB in their analysis.

[29]Battini and Yates (2003) consider what they describe as hybrid inflation and PLT. The central bank is assigned an objective that combines both inflation and the price level, and optimal tradeoff frontiers are mapped. They argue that much of the benefit of PLT is obtained when only a small weight is placed on the price level in the objective that guides the design of policy. See also Billi (2008).

[30]They also provide references to the related literature investigating PLT with nominal contracts.

[31]For example, if $i_t = r_t^n + \delta\left(p_t - p^*\right)$, then the Fisher equation implies:

$$i_t = r_t^n + \mathrm{E}_t \pi_{t+1} = r_t^n + \delta\left(p_t - p^*\right),$$

so

$$\mathrm{E}_t p_{t+1} = \left(1+\delta\right) p_t - \delta p^*.$$

For any $\delta > 0$, $p_t = p^*$ is the unique solution, but there exists deflationary solutions beginning at any $p' < p^*$ such that $i \rightarrow 0$.

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