

Comments on:  
“The Zero Bound on Interest Rates and  
Optimal Monetary Policy”  
by Eggerston and Woodford\*

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## 1 Introduction

This is the kind of paper I like a lot. The topic is important and highly relevant to current events. Also, as I would expect from these authors, the paper contains some interesting and innovative theoretical contributions.

The paper picks up two themes from Paul Krugman’s earlier work on this subject. The first is that a central bank may be able to lift an economy out a liquidity trap if it can create expectations that it will be expansionary in the future. Second, creating these expectations is a nontrivial matter: It involves making a credible commitment to stick to an inflationary policy in the future, after the time the economy has evolved from the liquidity trap.

The paper goes beyond Krugman’s analysis in several significant ways. First it presents a theoretical model that adds some empirical richness to the descriptive detail. Second, it characterizes the optimal policy. Finally, it translates the optimal policy into an operational rule that has a distinct real world interpretation.

A major theme of the paper is that economies slip into a liquidity trap when the natural (i.e. flexible price equilibrium) real interest rate is negative and emerge from the trap when this rate returns to being positive.

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The authors assume that the natural real rate follows an exogenous process and then study the behavior of monetary policy conditional on this process. As I discuss below, however, an economy on the verge of a liquidity trap or directly enmeshed in one may also want to consider policies that directly influence the equilibrium real rate. A natural candidate is a transitory fiscal policy. In this regard, for an economy truly threatened by a liquidity trap, a coordinated fiscal/monetary effort may be desirable. This point, of course, goes back to Keynes, but can be illustrated sharply within a modest variation of the authors' contemporary framework.

In the next section I exposit the key aspects of the authors' analysis and then offer a few comments. I then describe how a slight extension of the framework suggests a role for coordinated monetary/fiscal efforts. For countries with malfunctioning credit systems, such as Japan, financial restructuring should also be factored into the policy mix.

## 2. The Model.

The model is a simple general equilibrium framework with money and nominal rigidities in the form of staggered multi-period price setting. Let  $x_t$  be the percent deviation of output from its natural (flexible price equilibrium) level;  $\pi_t$  be inflation,  $i_t$  the nominal rate of interest and  $r_t^n$  the natural rate of interest. After loglinearizing around the deterministic steady state, it is possible to collapse the model into the following simple system, consisting of an "IS curve" and Phillips curve, as follows

$$x_t = \sigma[r_t^n - (i_t - E_t\pi_{t+1})] + E_t x_{t+1} \quad (1)$$

$$\pi_t = \kappa x_t + \beta E_t \pi_{t+1} \quad (2)$$

The IS curve relates the output gap positively to the gap between the natural real rate and the current market real rate and to expected future output gap. The Phillips curve, in turn, relates inflation to the output gap and to expected future inflation. The nominal rate  $i_t$  is the instrument of monetary policy. Overall, the model describes the behavior  $x_t$  and  $\pi_t$ , conditional on the exogenous path of  $r_t^n$  and the central banks' choice of  $i_t$ .

The central bank would like to maintain price stability (keep  $\pi_t$  close to zero) and stabilize the output gap (keep  $x_t$  close to zero.) It manipulates  $i_t$  to accomplish these goals. It cannot, however, reduce  $i_t$  below zero: That is, it faces the following zero lower bound constraint on  $i_t$ :

$$i_t \geq 0 \tag{3}$$

As the authors analysis makes quite clear, the lower bound constraint binds when the natural real rate is negative: In this situation the economy slips into a liquidity trap, assuming there is no expectation of excess demand in the future. When  $r_t^n < 0$  and  $E_t x_{t+1} \leq 0$ , a negative market real rate is required to keep output from slipping below the natural level, as equation (1) makes clear. Given the lower bound constraint, however, a negative real rate can arise only if there is expected inflation over the next period. The latter cannot occur, however, if the private sector does not expect excess demand to arise in the future (i.e. if  $E_t x_{t+1+i} \leq 0$ , for all  $i$ .) In this situation, accordingly, excess supply ( $x_t < 0$ ) and deflation ( $\pi_t < 0$ ) emerge.

As originally Krugman originally emphasized, even if the lower bound constraint is binding, a central bank can still provide stimulus if it can influence beliefs about the future course of monetary policy. The authors framework is very useful for illustrating this point: Here expectations of the future path of the nominal rate affect current economic behavior. To see directly, iterate equations (1) and (2) forward to obtain:

$$x_t = E_t \left\{ \sum_{i=0}^{\infty} \sigma [r_{t+i}^n - (i_{t+i} - E_{t+i} \pi_{t+1+i})] \right\} \tag{4}$$

$$\pi_t = E_t \left\{ \sum_{i=0}^{\infty} \beta^i \kappa x_{t+i} \right\} \tag{5}$$

Beliefs about future policy translate into expectations of the future path of the real interest rate gap. In turn, expectations of the future path of the interest gap affect the current output gap. They also affect current inflation by affecting both the current and the expected future path of the output gap.

### 3. Monetary Policy in the Liquidity Trap.

It follows that even if the central bank is currently powerless to reduce the nominal rate, it can still stimulate current economic activity by credibly committing to adopt an expansionary policy once the economy is free of the liquidity trap. Consider the following simple example: Suppose that the natural real rate is expected to be negative for  $T$  periods, before turning positive indefinitely; i.e.,  $r_{t+i}^n < 0$  for  $i \in [0, T - 1]$ ,  $r_{t+i}^n > 0$  for  $i > T$ .

Given that the lower bound constraint is binding for the first  $T$  periods, it is possible to express the output gap as

$$\begin{aligned}
 x_t &= E_t\left\{\left[\sum_{i=0}^{T-1} \sigma(r_{t+i}^n + \pi_{t+1+i})\right] + x_{t+T}\right\} \\
 &= E_t\left\{\sum_{i=0}^{T-1} \sigma(r_{t+i}^n + \pi_{t+1+i}) + \sum_{i=T}^{\infty} \sigma[r_{t+i}^n - (i_{t+i} - \pi_{t+1+i})]\right\}
 \end{aligned} \tag{6}$$

Observe that the central bank can raise  $x_t$  by committing to reduce  $i_t$  sufficiently in periods  $t + T$  and after. This transmission mechanism involves two channels: First, the expected path of  $i_t$  in the post-liquidity trap period affects current spending: As equation (6) indicates, holding constant expected inflation, a decline in expected future nominal rates will directly raise  $x_t$ . Second, the resulting increase in current and expected future values of  $x_t$  stimulates inflation which, in turn reduces real interest rates, further enhancing current demand. Krugman has emphasized this latter channel. The analysis of the former, however, is new.

Equation (6) also reveals some intuition for the authors' proposition that open market purchases are ineffective when the economy is stuck in a liquidity trap, unless these operations influence beliefs about the "post-trap" behavior of interest rates. When the zero bound constraint is binding and fiscal policy is held constant, an open market purchase affects neither nominal rates nor private sector wealth.<sup>1</sup> It thus cannot affect current spending unless it somehow influences beliefs about the path of nominal rates in the post-trap era. This proposition is highly relevant to the discussion of what policies to pursue in the event a liquidity trap threatens, particularly the proposal buy long term bonds. The authors proposition shows that this policy will be ineffective, unless it alters beliefs about expected future short rates.<sup>2</sup>

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<sup>1</sup>The authors derive their irrelevance proposition for a more general case where utility is nonseparable in real money balances and consumption. However, in the liquidity trap, real money balances are beyond the satiation point and do not affect the marginal utility of consumption. Open market purchases, accordingly have not effect in this more general case, either.

<sup>2</sup>Note also that the authors proposition still applies even if the government buys risky assets. In this instance, the private sector will still bear the risk through fluctuating taxes. However, the authors irrelevance theorem (as are all Miller-Modigliani theorems) is based on the assumption of perfect capital markets. This suggests that it may be necessary to

The nature of the time consistency problem also becomes transparent from equation (6). To stimulate the economy, the central bank clearly would like to create the expectation that it will be expansionary once it regains its ability to directly manipulate short term rates. This requires committing to keep the interest gap,  $r_{t+i}^n - (i_t - E_{t+i}\pi_{t+1+i})$ , positive for a number of periods after  $T - 1$ . Once the economy is out of the liquidity trap, however, the central bank prefers to concentrate on maintaining price and output gap stability. The best way to achieve these goals is to adjust the nominal rate to fix the interest rate gap at zero. Doing so, however, would involve renegeing on the earlier pledge to keep this gap positive for a period of time.

#### 4. Optimal Monetary Policy in a Liquidity Trap

A significant contribution of the paper is to characterize the optimal policy in the liquidity trap. Here the central bank trades off the current gain from creating expectations that future policy will be expansionary versus the cost of having to stick to this expansionary policy once the economy is free of the liquidity trap. As the authors show, when the central bank is free to manage nominal rates, it should do so to adjust demand to stabilize the price level around the target  $p_t^*$ . This strategy, in turn, results in  $x_t$  responding in a “lean against the wind” fashion (when  $i_t > 0$ ) as follows:

$$x_t = -\frac{\kappa}{\lambda_x}(p_t^* - p_t) \quad (7)$$

However, if the lower bound constraint is binding, the central bank should set  $i_t = 0$  and ratchet up the target price level for next period, using the following updating rule:

$$p_{t+1}^* - p_t^* = \beta^{-1}[a(p_t^* - p_t) + \pi_t^* - \pi_t] \quad (8)$$

Intuitively, by committing to the price level targeting rule when the economy is free of the liquidity trap, the central bank creates the expectation that it will offset any deflationary pressures in the present with expansionary policy in the future. This threat to become expansionary, in turn, mitigates the pain of the liquidity trap. By ratcheting the price level target up if the

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appeal to capital market frictions to justify the intervention in the long term bond market (or to the notion that this would send a signal about future short rates, in line with the authors’ arguments.)

liquidity trap materializes, the central bank meets strong deflationary pressures with a commitment to intensify its future expansionary policy. The authors show, however, that a simpler policy that keeps the path of the price level target invariant to current conditions closely approximates the optimal policy, under reasonable assumptions about parameter values.

The benefit of a price level target over an inflation target to fight deflation is reasonably straightforward. It meets enhanced deflationary pressures with an intensified commitment to be expansionary in the future (even if the target price level is unchanged). An inflation target, on the other hand, lets “bygones be bygones.” That is, an usual drop in prices today does not affect the course of policy in the future since under inflation targeting a central bank is only focused on the current rate of change of prices. Thus inflation targeting does not induce the same kind of stabilizing adjustment of expectations about the future course of policy, as does price level targeting.

Of course, the authors result that price level targeting is optimal requires several qualifications. First, the simple form of the price level targeting rule is in large part a product of the pure forward looking phillips curve, given by equation (2). While this phillips curve is useful for gaining insight into how central banks should factor private sector expectations into policy management, the baseline version used by the authors does not capture the high persistence of inflation observed in the data. However, as Gali and Gertler (1999) show, a hybrid variant of equation (2) that allows for a mixture of forward and backward looking behavior does a reasonably good job.<sup>3</sup> Because forward looking behavior remains important under this empirical specification, the authors qualitative conclusions regarding the importance of managing future expectations will survive. However, because inflation depends on lagged inflation as well as expected future inflation, it will no longer be optimal to simply target the price level and ignore past inflation.

Second, the issue of time consistency remains. That is, while the price level target helps minimize the damage to the economy from being in a liquidity trap, once out of the trap the central bank would like to abandon it. The authors clearly recognize this issue and propose a number of ways to properly align the central bank’s incentives. Whether, these strategies would work in practice, especially for an economy like the U.S., remains an open question. To date, price level targeting has not had much appeal. One reason for this may be that, as I suggested earlier, price level targeting is most

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<sup>3</sup>The hybrid variation is given by  $\pi_t = \kappa x_t + \gamma^f E_t \pi_{t+1} + \gamma^b \pi_{t-1}$ .

appealing when price setting is purely forward looking. The belief that at least a component of inflation is backward looking naturally raises concerns about adopting a simple price level target.

## 5. Fiscal Policy and Financial Restructuring

The point that the liquidity trap is ultimately a product of having a negative natural rate of interest, while highly transparent in the authors' analysis, is also inherent in the traditional IS/LM description of this phenomenon. Within this traditional apparatus, a liquidity trap emerges when the IS curve intersects the long run aggregate supply curve at a negative interest rate. Expectations of future policy play no role, however, in contrast to the authors' analysis.

The traditional prescription for curing the liquidity trap, of course, is expansionary fiscal policy. Fiscal stimulus shifts the IS curve shift outward to the point where the IS curve intersects the long run aggregate supply curve at a positive interest rate. A suitably accommodative monetary policy, of course, should also be part of the overall package.

Expansionary fiscal policy (along with monetary accommodation) is also a natural path to take within the authors' framework. As in the traditional analysis, this policy if used effectively attacks the heart of the problem by pushing the natural rate of interest into the positive region. Because the authors framework is more highly structured than the IS/LM model, some subtleties emerge about the nature of the desired intervention that are not present in the traditional analysis.

For example, suppose we modify the author's framework to allow for government consumption as well as private consumption. Then let  $g_t$  be the log of government consumption and  $a_t$  be the log of technology. Then it is straightforward to show that the natural rate of interest is (approximately) the following implicit function of the expected growth rate of technology and the expected growth rate of government expenditures:

$$r_t^n = \rho(E_t a_{t+1} - a_t, E_t g_{t+1} - g_t); \quad \rho_1 > 0, \rho_2 < 0 \quad (9)$$

The equilibrium real rate depends positively on expected productivity growth and negatively on the expected growth rate of government expenditures. Intuitively, the latter raises expected consumption growth (thus pushing up the real rate) while the latter reduces expected consumption growth.

Suppose now that, holding constant fiscal policy,  $r_t^n$  becomes negative for a period of time due to a transitory period of negative productivity growth. In the absence of any policy response, the liquidity trap emerges. However, by pursuing a sufficiently aggressive transitory increase in government expenditures, the fiscal authority can push the natural rate into the positive region, this avoiding the liquidity trap. An important difference from the traditional analysis is for the government to commit to making the expansion transitory: If the private sector perceives it as permanent it will not affect the natural rate<sup>4</sup>.

I am not suggesting fiscal policy as a substitute for the author's monetary prescription but rather as a complementary policy initiative. One virtue of this approach is that it involves offering direct stimulus to the economy as opposed to resting hopes entirely on private sector expectations of future (monetary) stimulus. Of course, before any firm conclusions may be drawn, a formal analysis of fiscal policy along the lines of the authors' analysis of monetary policy would be desirable. Along these lines, modifying the authors' framework to allow for fiscal tools would seem to provide a good starting point.

Finally, it is important to recognize that malperformance of credit markets is a key feature of economies truly enmeshed in a liquidity trap, such as the U.S. economy during the Great Depression and the current Japanese economy. At a conceptual level, credit market frictions raise the likelihood that the zero bound constraint will bind. They do so by reducing the market real interest rate required to produce zero excess demand (i.e.,  $x_t = 0$ .) To see, consider the following very stylized example. Suppose that  $\chi_t$  is the premium for external finance that borrowers must pay, owing to the presence of capital market frictions. This premium will depend on factors such as borrowers' collateral and the overall conditions of financial institutions, etc. In this environment, the opportunity cost of investing is given by,  $\chi_t + i_t - E_t \pi_{t+1}$ , implying that the interest rate gap is now given by  $r_t^n - \chi_t + i_t - E_t \pi_{t+1}$ , where  $r_t^n$  now has the interpretation of being the natural rate in the absence of credit market frictions. In this instance, the zero bound constraint will bind if

$$r_t^n - \chi_t < 0$$

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<sup>4</sup>In a model with capital, permanent shifts in government expenditures can affect the natural rate of interest, though transitory movements will have a larger effect.

Since  $\chi_t > 0$ , financial market frictions raise the likelihood that the economy will slip into a liquidity trap. Intuitively, the rise in the cost of credit owing to these frictions requires lower riskless market rates than otherwise to keep overall borrowing costs from stifling demand and edging the economy into a deflation. To the extent financial reforms and financial market restructuring reduce  $\chi_t$ , they help ease the economy out of the liquidity trap. As with fiscal policy, credit market improvements potentially provide direct stimulus for an economy in the midst of a liquidity trap.

## References

- [1] Eggertson, Gauti and Michael, Woodford, 2003, “The Zero Bound on Interest Rates and Optimal Monetary Policy,” mimeo.
- [2] Gali, Jordi and Mark Gertler, 1999, “Inflation Dynamics: A Structural Econometric Analysis,” *Journal of Monetary Economics* 44, pp. 195-222.