E C O N O M I C S   B U L L E T I N

Speed Limit Policies and Interest Rate Smoothing

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Abstract

Walsh (2003) argued that U.S. monetary policy can be described as following a "speed limit" policy. Here I show that this provides an explanation for the apparent interest rate smoothing present in central bank policy.

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1. Introduction

Walsh (2003) argued that U.S. monetary policy can be described as following a "speed limit" policy, where the output gap is replaced by the change in the output gap in the loss function of the central bank. He demonstrates that this moves the discretionary policy in the direction of the optimal commitment solution and argues that it is consistent with the language used by members of the Federal Open Market Committee to describe the policy process. Here, I show that a speed limit policy solves a puzzle in the monetary policy literature: the apparent importance in interest rate smoothing as an objective for monetary policy (Cobham 2003; Ozlale 2003). Speed limit policies and smoothing interest rates are shown to be observationally equivalent in a simple New Keynesian model. This explanation is complementary to existing explanations for interest rate smoothing in the literature: the serial correlation of shocks (Rudebusch 2002), and the use of real-time data in monetary policy decisions (Lansing 2002). A speed limit policy is also contrasted with a price level target, which has also been shown to improve discretionary policy outcomes (Vestin 2000).

2. The Model

Suppose, as in Vestin (2000), Walsh (2003), and Yetman (2003, 2004), that the economy consists of a Phillips curve given by

$$\pi_t = \beta E_t(\pi_{t+1}) + \kappa x_t + u_t, \tag{1}$$

where π_t is inflation, x_t is the output gap and u_t is an exogenous shock term that is known by the central bank. Expectations of future inflation are assumed rational, and all variables are expressed in logs.

An inflation-targeting central bank seeks to minimize a standard, quadratic loss function given by

$$L^I = \sum_{i=0}^{\infty}[(\pi_{t+i} - \pi^*)^2 + \lambda x_{t+i}^2], \tag{2}$$

subject to (1), for some inflation target π^*. Under discretionary policy, the central bank is assumed to lack the means to commit to future policy actions. Optimal monetary policy will therefore minimize the period loss function, taking the form

$$x_t = \frac{\kappa(1-\beta)}{\kappa^2 + \lambda(1-\beta)}\pi^* - \frac{\kappa}{\kappa^2+\lambda}u_t, \tag{3}$$

while inflation evolves according to

$$\pi_t = \frac{\kappa^2}{\kappa^2 + \lambda(1-\beta)}\pi^* + \frac{\lambda}{\kappa^2+\lambda}u_t. \tag{4}$$

With a price level target, note that (1) may be rewritten as

$$E_t(p_{t+1} - p_{t+1}^*) = \frac{1+\beta}{\beta}(p_t - p_t^*) - \frac{1}{\beta}(p_{t-1} - p_{t-1}^*) - \frac{\kappa}{\beta}x_t - \frac{1}{\beta}u_t + \frac{1-\beta}{\beta}\pi^*, \tag{5}$$

where $p_t^* = p_{t-1}^* + \pi^*$. The appropriate quadratic period loss function is then given by

$$L_t^P = (p_t - p_t^*)^2 + \lambda x_t^2, \tag{6}$$

where λ is appropriately scaled to reflect the difference between the magnitude of price level and inflation rate volatility. In contrast to inflation targeting, today's policy affects losses in future periods, implying the presence of state variables in the model. Following the methodology of Currie and Levine (1993), the paths of output and inflation under optimal discretionary monetary policy may be defined by

$$x_t = \theta_1[(p_{t-1} - p_{t-1}^*) + u_t] + \theta_2, \tag{7}$$

$$(p_t - p_t^*) = \phi_1[(p_{t-1} - p_{t-1}^*) + u_t] + \phi_2, \tag{8}$$

where

$$\theta_1 = \frac{-\kappa(1+\beta\nu_1)}{\kappa^2(1+\beta\nu_1) + \lambda(1+\beta-\beta\phi_1)^2},$$

$$\theta_2 = -\frac{\kappa(1+\beta\nu_1)[\beta\phi_2 - (1-\beta)\pi^*] + \kappa\beta\nu_2(1+\beta-\beta\phi_1)}{\kappa^2(1+\beta\nu_1) + \lambda(1+\beta-\beta\phi_1)^2},$$

$$\phi_1 = \frac{\lambda(1+\beta-\beta\phi_1)}{\kappa^2(1+\beta\nu_1) + \lambda(1+\beta-\beta\phi_1)^2},$$

$$\phi_2 = \frac{\lambda(1+\beta-\beta\phi_1)[\beta\phi_2 - (1-\beta)\pi^*] - \kappa^2\beta\nu_2}{\kappa^2(1+\beta\nu_1) + \lambda(1+\beta-\beta\phi_1)^2},$$

$$\nu_1 = (1+\beta\nu_1)\phi_1^2 + \lambda\theta_1^2,$$

$$\nu_2 = (1+\beta\nu_1)\phi_1\phi_2 + \lambda\theta_1\theta_2 + \beta\nu_2\phi_1.$$

To examine monetary policy with a speed limit policy, the appropriate quadratic period loss function is

$$L_t^S = (\pi_t - \pi^*)^2 + \lambda(x_t - x_{t-1})^2, \tag{9}$$

where λ should again be scaled to reflect the difference between the magnitude of output gap volatility and the volatility of the change in the output gap. As in Walsh (2003), the paths of output and inflation under optimal discretionary monetary policy may be defined by

$$x_t = \xi_0 + \xi_1 x_{t-1} + \xi_2 u_t, \tag{10}$$

$$\pi_t = \zeta_0 + \zeta_1 x_{t-1} + \zeta_2 u_t, \tag{11}$$

$$\xi_0 = \frac{(\beta\zeta_1 + \kappa)(\pi^* - \beta\zeta_0) - \beta\rho_2}{(\beta\zeta_1+\kappa)^2 + \lambda + \beta\rho_1},$$

$$\xi_1 = \frac{\lambda}{(\beta\zeta_1+\kappa)^2 + \lambda + \beta\rho_1},$$

$$\xi_2 = \frac{-(\beta\zeta_1 + \kappa)}{(\beta\zeta_1 + \kappa)^2 + \lambda + \beta\rho_1},$$

$$\zeta_0 = \beta\zeta_0 + (\beta\zeta_1 + \kappa)\xi_0,$$

$$\zeta_1 = (\beta\zeta_1 + \kappa)\xi_1,$$

$$\zeta_2 = (\beta\zeta_1 + \kappa)\xi_2 + 1,$$

$$\rho_1 = \frac{\zeta_1^2 + \lambda(\xi_1 - 1)^2}{1 - \beta\xi_1^2},$$

$$\rho_2 = \frac{\zeta_1(\zeta_0 - \pi^*) + \lambda\xi_0(\xi_1 - 1) + \beta\rho_1\xi_0\xi_1}{1 - \beta\xi_1}.$$

To investigate the relationship between interest rate smoothing and the period loss function of the central bank, consider an IS curve given by

$$x_t = -\gamma(r_t - r^*), \tag{12}$$

where r^* is the natural real interest rate, and r_t is assumed to be the policy instrument of the central bank. Then it is straight-forward to show that the period loss functions may be re-written as

$$L_t^I = (\pi_t - \pi^*)^2 + \lambda\gamma^2(r_t - r^*)^2, \tag{13}$$

$$L_t^P = (p_t - p_t^*)^2 + \lambda\gamma^2(r_t - r^*)^2, \tag{14}$$

$$L_t^S = (\pi_t - \pi^*)^2 + \lambda\gamma^2(r_t - r_{t-1})^2. \tag{15}$$

Clearly a speed limit policy is consistent with interest-rate smoothing, while either a price level or inflation target is consistent with minimizing the volatility of real interest rates about their natural level. However, because a price level target embeds history dependence within the price level objective, it is not clear whether a price level target results in increased or decreased real interest rate smoothing relative to the other policies.

3. Results and Conclusions

To further investigate the relationship between these different types of loss function and interest rate smoothing, we plot inflation volatility against volatility in the change of the interest rate for different values of λ. The parameters considered here are the same as in Vestin (2000) and Yetman (2003, 2004): $\kappa = \frac{1}{3}$; $\beta = 1$; $\pi^* = 0$; and $0 \leq \lambda \leq \infty$. The results are given in Figure 1 for the real interest rate and Figure 2 for the nominal interest rate. It is clear that by either measure, a price level target or a speed limit policy will result in an apparent increase in interest rate smoothing relative to that which would be achieved with an inflation target. Evidence of interest rate smoothing can be interpreted as evidence of price level targeting or a speed limit policy for the conduct of monetary policy under discretion.

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Figure 1. Real Interest Rate

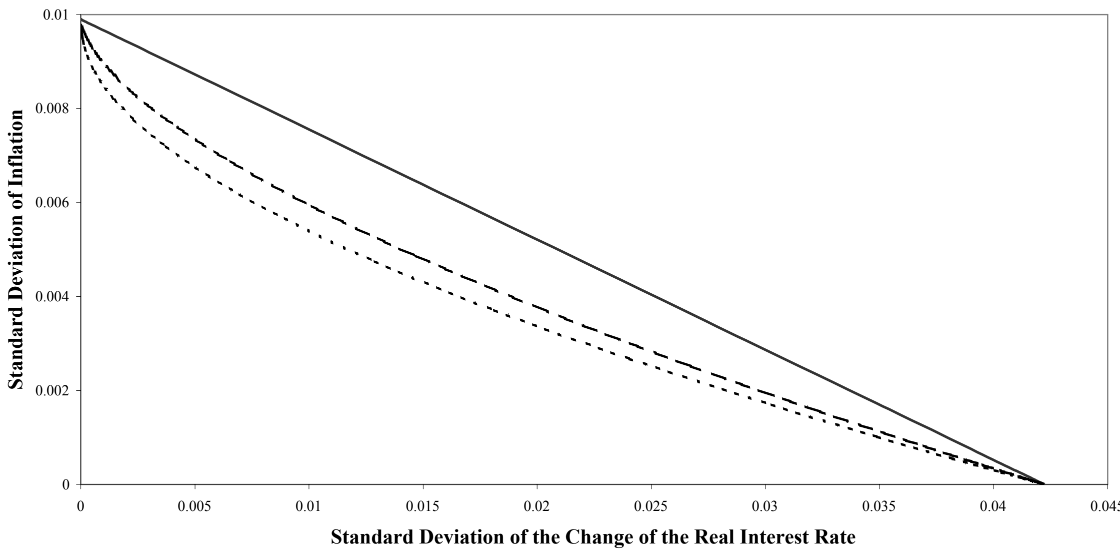

Figure 2. Nominal Interest Rate