Optimal monetary policy and the term structure of interest rates: a note

Sylvia Staudinger
Technische Universität Wien, Vienna, Austria

Keywords *Interest rates, Inflation*

Abstract *This paper derives the optimal monetary policy under discretion, taking into account that aggregate spending depends on the long-term real interest rate rather than on the short-term rate. It deduces optimal shock-dependent strategies for the monetary instrument, the nominal interest rate and analyzes the influence of both the degree of persistence of supply and demand shocks and the weight on output stabilization in the objective function of the central bank on the optimal monetary reaction. The higher the degree of persistence of a supply shock, the stronger is the reaction of the interest rate, whereas the opposite holds for a demand shock. The reaction on demand disturbances is independent of weight given to output stabilization by the central bank; in the case of a supply shock the reaction of the interest rate depends on this weight.*

Introduction

The aim of this paper is to analyze how the optimal monetary policy of the ECB should work. In contrast with many other papers dealing with this subject (see, for example, Clark *et al.*, 1999; Svensson, 1997, 1999) we take into account that investment decisions and therefore aggregate demand depend crucially on the long-term real interest rate rather than on the short-term real rate.

To describe the term structure of interest rates we use the pure expectations hypothesis (PEH). In contrast with other work, which found empirical failures of the PEH, McCallum (1994), Rudebusch (1995), Fuhrer (1996) and Balduzzi *et al.* (1997) emphasized that changes in monetary policies explain many of these failures and, taking into account these changes, the PEH significantly improves its performance.

In this paper we use targeting in the sense of Svensson (1997, 1999) or Rudebusch and Svensson (1999), meaning that the target variable is an argument of a particular loss function that has to be minimized. We assume the most realistic scenario, namely that the ECB has the same kind of inflation target.

Inflation targeting has been adopted by the central banks of New Zealand, the UK and some other countries in the last decade (for a detailed theoretical and empirical analysis of these countries see Bernanke *et al.* (1999) or Leiderman and Svensson (1995)).

The two major advantages of inflation targeting are transparency, in the sense that policy objectives are highly visible to the public, and accountability, that is to provide a clear and measurable benchmark to evaluate the bank's performance. The disadvantage of inflation targeting is the long and variable lags between monetary policy and the rate of inflation; therefore the CB has

Journal of Economic Studies,
Vol. 29 No. 2, 2002, pp. 98-108.
© MCB UP Limited, 0144-3585
DOI 10.1108/01443580210420763

only imperfect control of inflation. The effects of any change in the monetary base will not be ascertained for one year or possibly longer.

Therefore Svensson (1997) suggests that inflation targeting should be implemented as inflation forecast targeting, such that the CB inflation forecast is treated as an explicit intermediate target. The CB has to set its instrument, the nominal interest rate such that the current inflation forecast equals the inflation target. If the forecast is on target, monetary policy is appropriate. If the inflation forecast is above (below) the target, the interest rate should be increased (decreased).

Ellingsen and Söderström (1999) investigate in their paper the relationship between monetary policy and the term structure of interest rates. They use a backward-looking framework like Svensson to analyze the effects of monetary policy on market interest rates. They find that, if monetary policy responds to economic developments, in the model reflected by a shock, then interest rates of all maturities move in the same direction. If monetary policy reveals a change in the preferences of the central bank, in the model this means a change in the weight given to output stabilization, then short-term and long-term interest rates move in opposite directions.

The main results of our work are that optimal policy varies with the degree of persistence in supply and demand shocks. The higher the degree of persistence, the stronger is the optimal reaction of the monetary instrument. The higher the degree of persistence of a supply shock, the stronger is the adjustment of the nominal interest rate, whereas the opposite is true for a demand shock. The reaction on demand disturbances is independent of the weight given to output stabilization by the central bank; in the case of a supply shock the reaction of the interest rate depends on this weight.

The model

We use a simple dynamic equilibrium model as the framework for our analysis:

$$\pi_t = E_t\pi_{t+1} + a(y_{t-1} - y^n) + \varepsilon_t, \tag{1}$$

$$y_t = y^n - bR_t + \eta_t, \tag{2}$$

$$r_t = i_t - E_t\pi_{t+1}, \tag{3}$$

$$R_t = \frac{1}{2}(r_t + E_t r_{t+1}) = \frac{1}{2}(i_t - E_t\pi_{t+1} + E_t i_{t+1} - E_t\pi_{t+2}). \tag{4}$$

The model contains a Phillips curve (Equation (1)) that relates inflation positively to the output gap of the last period and an IS-curve (Equation (2)) that relates output negatively to the long-term real interest rate. Looking at Equation (1) $E_t\pi_{t+1}$ is the expected inflation rate of the next period based on the information available in period t. ε_t denotes a supply shock.

The expectation-augmented Phillips curve can be thought of as an approximation of a new Keynesian model like the models of staggered contracts (Taylor, 1979; Calvo, 1983) or the model of quadratic price adjustment (Rotemberg, 1982). These models are briefly summarized in Roberts (1995).

In Equation (2) y^n denotes the natural output and η_t a demand shock, not correlated with the supply shock.

As opposed to Ellingsen and Söderström we specify a forward-looking version of the Phillips curve rather than a backward-looking version and the long-term real rate is the important interest rate for aggregate demand rather than the short-term rate.

The long-term real interest rate (Equation (4)) follows the pure expectations hypothesis (PEH) and is equal to the average of the current short-term interest rate r_t and the expected next period short term rate $E_t r_{t+1}$. The short-term rate (Equation (3)) is simply the nominal interest rate minus the expected inflation rate. All expectations are formed on the information available in period t:

$$\varepsilon_t = \theta\varepsilon_{t-1} + \xi_t, \tag{5}$$

$$\eta_t = \rho\eta_{t-1} + v_t. \tag{6}$$

Both disturbances follow a first-order autoregressive process with $0 \leq \theta, \rho \leq 1$. ξ_t, v_t are i.i.d. random variables with zero mean and variance σ_ξ^2 and σ_v^2.

The central bank objective function is:

$$E_t \sum_{j=0}^{\infty} \frac{1}{2} \delta^j L_{t+j}, \tag{7}$$

where L_{t+j} is a standard quadratic loss function:

$$L_{t+j} = (\pi_{t+j} - \pi^*)^2 + \Phi(y_{t+j} - y^n)^2. \tag{8}$$

The loss of the central bank increases with deviations from natural output y^n and increases also if inflation deviates from an exogenously given inflation target π^*. Since the target for output is the natural rate, there is no incentive to create an inflation bias. Φ measures the weight policymakers give to output stabilization relative to inflation stabilization and lies between 0 and infinity. $\Phi = 0$ coincides with a regime that Svensson (1997) denominates as strict inflation targeting, $\Phi > 0$ with flexible inflation targeting. The instrument of the monetary authority is the nominal interest rate i_t and the central bank controls the nominal rate to affect output and inflation.

Substituting Equation (4) into Equation (2) yields:

$$y_t = y^n + \eta_t - \beta(i_t - E_t\pi_{t+1} + E_t i_{t+1} - E_t\pi_{t+2}), \tag{9}$$

where $\beta = \frac{b}{2}$.

Using this equation in Equation (1) and taking into account the time-lag give:

$$\pi_{t+1} = E_{t+1}\pi_{t+2} + a(\eta_t - \beta(i_t - E_t\pi_{t+1} + E_t i_{t+1} - E_t\pi_{t+2})) + \theta\varepsilon_t + \xi_{t+1}. \tag{10}$$

These two equations show the relationship between output and inflation and the control variable i_t. An increase in the current or expected future nominal interest rate unambiguously reduces both output and inflation.

Optimal monetary policy

In this section we deduce the optimal policy of the central bank under discretion. As Clarida *et al.* (1999) argues discretion is the scenario which fits best reality, since no central bank will make any binding commitments over the future course of its policy.

Bernanke *et al.* (1999, Chs 1 and 2) suggest that inflation targeting should be only a framework for monetary policy which allows for the exercise of "constrained discretion", but should not be interpreted as classical rule. Without commitment the central bank takes expectations as given in the optimization problem and chooses the nominal interest rate which minimizes the loss function. The private sector forms its expectations rationally conditional on the central bank's optimal policy rule.

Since i_t affects only y_t and π_{t+1} and there is no endogenous state variable, the optimization problem reduces to the following simple intertemporal optimization problem:

$$E_t \frac{1}{2}\left(\left((\pi_t - \pi^*)^2 + \Phi(y_t - y^n)^2\right) + \delta\left((\pi_{t+1} - \pi^*)^2 + \Phi(y_{t+1} - y^n)^2\right)\right), \tag{11}$$

subject to Equations (9) and (10).

Differentiating Equation (11) with respect to i_t and taking expectations, we obtain the following optimality condition:

$$\Phi(y_t - y^n) = -\delta a(E_t\pi_{t+1} - \pi^*). \tag{12}$$

This condition can be interpreted as follows: expected inflation should be above its target proportional to the deviation from current output from its natural rate.

The proportionality coefficient depends on the weight given to output stabilization, the discount rate and the sensitivity of inflation to excess demand. If the central bank gives no weight to output stabilization, expected inflation should always be on target, a result that is consistent with the strict inflation-targeting scenario in Svensson (1997). The higher the weight the monetary authorities give to output stabilization, the more inflation should be expected to deviate from the target, if output falls short of its natural rate.

From the optimality condition it follows for i_t:

$$\begin{aligned}\beta i_t &= \eta_t + \beta(E_t\pi_{t+2} + E_t\pi_{t+1} - E_t i_{t+1}) \\ &+ \left(\delta a^2 + \Phi\right)^{-1}\delta a(\theta\varepsilon_t - \pi^* + E_t\pi_{t+2}).\end{aligned} \tag{13}$$

From this Equation it is apparent that the nominal interest rate i_t will be of the form:

$$i_t = a_0\varepsilon_t + a_1\eta_t + a_2\pi^*. \tag{14}$$

Shifting the time index one period ahead and taking expectations give the expected next period interest rate:

$$E_t i_{t+1} = a_0\theta\varepsilon_t + a_1\rho\eta_t + a_2\pi^*. \tag{15}$$

Substituting Equations (14) and 15) into Equation (10) yields:

$$\begin{aligned}&\pi_{t+1} = E_{t+1}\pi_{t+2} + a\eta_t - a\beta \\ &(a_0\varepsilon_t(1+\theta) + a_1\eta_t(1+\rho) + 2a_2\pi^* - E_t\pi_{t+1} - E_t\pi_{t+2}) + \theta\varepsilon_t + \xi_{t+1}.\end{aligned} \tag{16}$$

To determine π_{t+1} we employ the technique of undetermined coefficients, where the bubble-free solution is obtained via a minimal-state-variable procedure (McCallum, 1983). The relevant state variables in Equation (16) are $\varepsilon_t, \eta_t, \pi^*$, ξ_{t+1} and ν_{t+1}(which will enter the solution via $E_{t+1}\pi_{t+2}$), so it is apparent that π_{t+1} will be of the form

$$\pi_{t+1} = b_0\varepsilon_t + b_1\eta_t + b_2\pi^* + b_3\xi_{t+1} + b_4\nu_{t+1}. \tag{17}$$

For the expectations we get:

$$E_t\pi_{t+1} = b_0\varepsilon_t + b_1\eta_t + b_2\pi^*,$$

$$E_t\pi_{t+2} = b_0\theta\varepsilon_t + b_1\rho\eta_t + b_2\pi^*,$$

$$E_{t+1}\pi_{t+2} = b_0(\theta\varepsilon_t + \xi_{t+1}) + b_1(\rho\eta_t + \nu_{t+1}) + b_2\pi^*.$$

Substituting these expressions for $E_t\pi_{t+1}, E_t\pi_{t+2}$ and $E_{t+1}\pi_{t+2}$ into Equation (16) and comparing it with Equation (17) yield the equations for the undetermined coefficients b_i; solving these equations for b_i, we obtain:

$$\begin{aligned}b_0 &= (1 - \theta - a\beta(1+\theta))^{-1}(\theta - a\beta a_0(1+\theta)) \\ b_1 &= (1 - \rho - a\beta(1+\rho))^{-1}(a - a\beta a_1(1+\rho)) \\ b_2 &= a_2 \\ b_3 &= b_0 + 1 \\ b_4 &= b_1.\end{aligned}$$

Substituting this solution into Equation (17) gives the solution for π_{t+1} as a function of the coefficients a_i. In the same way we calculate the expected values of future inflation and current output y_t as functions of a_i.

To deduce the coefficients a_i we use the optimality condition, substituting for $E_t\pi_{t+1}$ and y_t and determine the values for the coefficient a_i such that Equation (12) is satisfied. After some algebra we get:

$$a_0 = \theta\big(\beta(1+\theta)\big(\Phi(1-\theta)+\delta a^2\big)\big)^{-1}\big(\beta\Phi(1+\theta)+\delta a\big),$$
$$a_1 = \beta^{-1}(1+\rho)^{-1},$$
$$a_2 = 1.$$

Optimal policy requires the following rule for the nominal interest rate:

$$i_t = a_0\varepsilon_t + \beta^{-1}(1+\rho)^{-1}\eta_t + \pi^*. \tag{18}$$

We see that the nominal interest rate rises with both a positive supply or a demand shock in the current period. The higher the degree of persistence of a supply shock (a larger θ), the stronger is the reaction of the interest rate. On the other hand, a higher persistence of a demand shock (a larger ρ), to a smaller rise in the interest rate. The reaction on demand disturbances is independent of Φ; in the case of a supply shock the reaction of the interest rate depends on Φ, but is not unambiguous.

Shifting the time index one period ahead and taking expectations yield the expected interest rate for period $t+1$:

$$E_t i_{t+1} = a_0\theta\varepsilon_t + \rho\beta^{-1}(1+\rho)^{-1}\eta_t + \pi^*.$$

The expected next period nominal rate rises also with a positive supply or demand shock in the current period, but the expected reaction of the interest is smaller than the reaction of the current interest rate and with increasing θ and increasing ρ the degree of persistence of the shock increases. If there were only transitory shocks ($\theta = \rho = 0$), the expected interest rate would simply equal the inflation target.

Now substituting the coefficients of the interest rate rule into the coefficients b_i gives immediately the solution for π_{t+1}:

$$\pi_{t+1} = \big(\Phi(1-\theta)+\delta a^2\big)^{-1}\big(\Phi\theta\varepsilon_t + (\Phi+\delta a^2)\xi_{t+1}\big) + \pi^*. \tag{19}$$

We see that π_{t+1} increases with a higher target for the inflation rate and increases also with a higher preference for employment stabilization, i.e. if Φ increases. Moreover, one sees that demand shocks do not affect the inflation rate, since they are perfectly offset by an appropriate reaction in the interest rate. Since $\theta < 1$, the influence of a supply shock is gradually reduced and π converges to the target π^* in the long run, if no new shock occurs.

For the expected future inflation rates we obtain:

$$E_t\pi_{t+1} = \left(\Phi(1-\theta) + \delta a^2\right)^{-1}\theta\Phi\varepsilon_t + \pi^*,$$

$$E_t\pi_{t+2} = \left(\Phi(1-\theta) + \delta a^2\right)^{-1}\Phi\theta^2\varepsilon_t + \pi^*,$$

$$E_{t+1}\pi_{t+2} = \left(\Phi(1-\theta) + \delta a^2\right)^{-1}\theta\Phi(\theta\varepsilon_t + \xi_{t+1}) + \pi^*.$$

Expected future inflation goes up with a higher target and also with a higher weight Φ. Furthermore, expected inflation increases more, if the current supply shock is high (for $\theta > 0$), due to the persistence of supply shocks. The higher the degree of persistence (a larger θ), the higher the expected inflation rate for a given supply shock. Demand shocks do not affect the expected inflation rate, since the private sector takes into account the adjustment of the nominal interest rate, which offsets the demand shock.

For the current short-term real rate we obtain:

$$r_t = \left(\Phi(1-\theta) + \delta a^2\right)^{-1}\delta a\theta\varepsilon_t + \beta^{-1}(1+\rho)^{-1}\eta_t.$$

The nominal interest rate adjusts more than expected inflation, so the real short-term rate moves in the same direction as the nominal rate. This policy is also adopted by the Federal Reserve during the Volcker-Greenspan era to control inflation (Clarida *et al.*, 1998a, b). Since the early 1980s the Fed has raised systematically real and nominal short-term rates in response to higher expected inflation.

Deducing expected next period real rate we get:

$$E_t r_{t+1} = \left(\Phi(1-\theta) + \delta a^2\right)^{-1}\delta a\theta^2\varepsilon_t + \rho\beta^{-1}(1+\rho)^{-1}\eta_t.$$

The expected next period short-term rate also rises with a positive realization of a supply or demand shock, since the nominal rate increases more than expected inflation for period $t+2$, but the rise is smaller than the increase in the current short-term rate. Without persistence in the shocks the expected short-term rate is equal to zero, since both the expected nominal interest rate and expected inflation are equal to the inflation target.

What about the reaction in the long-term rate?:

$$R_t = \frac{1}{2}\left(\left(\Phi(1-\theta) + \delta a^2\right)^{-1}a\theta\delta(1+\theta)\varepsilon_t + b^{-1}\eta_t\right).$$

Clearly the long-term rate rises, if demand or supply shock occurs in response to higher expected inflation. The reaction in the long-term rate offsets demand shocks and reduces the impact of supply shocks. Comparing long-term and short-term rates we obtain that the direction of adjustment is equal for the two rates, but the reaction of the short-term is stronger than the reaction of the long-term rate. This result gives support to the result of Ellingsen and Söderström, who find that a response of monetary policy to a shock leads to a movement of interest rates of all maturities in the same direction.

Finally we use expected future inflation and interest rates in equation (9) to determine current output y_t:

$$y_t = y^n - \left(\Phi(1-\theta) + \delta a^2\right)^{-1} \delta a \theta \varepsilon_t. \qquad (20)$$

Since the long-term rate offsets demand shocks by reducing aggregate demand, output is only influenced by supply shocks. Deviation from the natural output increases with the degree of persistence of the supply shock and clearly decreases with weight on output stabilization.

Calculating the standard deviation of inflation π and output y, we get:

$$\sigma_\pi = \left(\Phi(1-\theta) + \delta a^2\right)^{-1} (\Phi + \delta a^2)\sigma_\xi,$$

$$\sigma_y = \left(\Phi(1-\theta) + \delta a^2\right)^{-1} \delta a \theta \sigma_\xi,$$

where σ_ξ is the standard deviation of the random component of the supply shock. There is a trade-off between output and inflation variability; with Φ increasing there is a lower standard deviation of output but the standard deviation of inflation increases.

Let us briefly turn to some special cases. First assume that the central bank follows a strict inflation target, i.e. $\Phi = 0$. In this case the solution reduces to:

$$i_t = (a\beta(1+\theta))^{-1}\theta\varepsilon_t + \beta^{-1}(1+\rho)^{-1}\eta_t + \pi^*,$$

$$\pi_{t+1} = \xi_{t+1} + \pi^*,$$

$$y_t = y^n - a^{-1}\theta\varepsilon_t.$$

All expected inflation rates and the expected nominal rate are equal to π^*, the inflation target. Since the monetary authorities do not care about output stabilization, deviations from the natural output are larger than for a flexible inflation target. The rise in the nominal interest rate is larger than in the case of flexible inflation targeting and is strong enough to offset the effect of current period supply and demand shocks on inflation. In the case of strict inflation targeting the standard deviations of output and inflation are:

$$\sigma_\pi = \sigma_\xi,$$

$$\sigma_y = a^{-1}\theta\sigma_\xi.$$

Next think about a situation where the central bank only cares about output stabilization but not about inflation stabilization, i.e. $\Phi \to \infty$:

$$i_t = \theta(1-\theta)^{-1}\varepsilon_t + \beta^{-1}(1+\rho)^{-1}\eta_t + \pi^*,$$

$$\pi_{t+1} = ((1-\theta))^{-1}(\theta\varepsilon_t + \xi_{t+1}) + \pi^*,$$

$$y_t = y^n.$$

Under this scenario the rise in the current and expected nominal interest rate is exactly equal to the rise in expected inflation and real rates remain unchanged, a situation that occurred in a similar way in the USA in the pre-Volcker-era (Clarida *et al.* 1998a, b). Owing to unchanged real rates output is always on its natural level at the expense of higher inflation. Looking at standard deviations, we obtain:

$$\sigma_\pi = (1-\theta)^{-1}\sigma_\xi,$$

$$\sigma_y = 0.$$

Another interesting extreme case is the situation where both kinds of shocks are completely transitory.

Substituting $\theta = \rho = 0$ into the general results leads to

$$i_t = \pi^* + \beta^{-1}\upsilon_t,$$

$$\pi_{t+1} = \xi_{t+1} + \pi^*,$$

$$y_t = y^n.$$

The most interesting point in this case is that the result does not depend on the weight on output stabilization. Now there is no trade-off between inflation and output and therefore it does not matter whether the central bank follows strict or flexible inflation targeting. If the shocks are only transitory, expected inflation rates as well as the expected nominal interest rate are equal to the inflation target. Therefore the expected next period short-term real rate is equal to zero and the long-term real rate equals the current short-term real rate. The nominal rate does not react to current period supply shocks and the adjustment of the instrument is appropriate to offset the current demand shock completely. Output is always at its natural level and the inflation rate in $(t+1)$ deviates from the target in the amount of the transitory supply shock in $(t+1)$. For the standard deviations we obtain:

$$\sigma_\pi = \sigma_\xi,$$

$$\sigma_y = 0.$$

Conclusions

In this paper we derived the optimal monetary policy, taking into account that aggregate spending depends on the long-term real interest rate rather than on the short-term rate. We assumed that supply and demand shocks are not purely transitory but follow an AR(1)-process. Furthermore, we analyze both strict and flexible inflation targeting.

The main findings of this work are: first, optimal strategies lead to a shock-dependent feedback rule. The optimal reaction of the monetary instrument, the nominal interest rate offsets demand shocks completely.

Second, optimal policy varies with the degree of persistence in supply and demand shocks. The higher the degree of persistence of a supply shock, the stronger is the reaction of the interest rate, whereas the opposite holds for a demand shock. The reaction on demand disturbances is independent of weight given to output stabilization by the central bank; in the case of a supply shock the reaction of the interest rate depends on this weight.

Third, there is a trade-off between output and inflation stabilization. This trade-off increases with the degree of supply shock persistence. Most interestingly we obtain that the trade-off between inflation and output stabilization vanishes, if shocks are only transitory. In this case output is completely stabilized and the deviation of inflation from the target is equal to the supply shock.

References

Balduzzi, P., Bertola, G., Foresi, S. and Klapper, L. (1997), "Interest rate targeting and the dynamics of short-term rates", NBER Working Paper 5944.

Bernanke, B., Laubach, T., Mishkin, F. and Posen, A. (1999), *Inflation Targeting*, Princeton University Press, Princeton, NJ.

Calvo, G.A. (1983), "Staggered contracts in a utility-maximizing framework", *Journal of Monetary Economics*, Vol. 12, pp. 383-98.

Clarida, R., Gali, J. and Gertler, M. (1998a), "Monetary policy rules and macroeconomic stability: evidence and some theory", CEPR Discussion Paper 1908.

Clarida, R., Gali, J. and Gertler, M. (1998b), "Monetary rules in practice: some international evidence", *European Economic Review*, Vol. 42, pp. 1033-68.

Clarida, R., Gali, J. and Gertler, M. (1999), "The science of monetary policy: a new Keynesian perspective", CEPR Discussion Paper 2139.

Clark, P., Goodhart, C. and Huang, H. (1999), "Optimal monetary policy rules in a rational expectations model of the Phillips curve", *Journal of Monetary Economics*, Vol. 43, pp. 497-520.

Ellingsen, T. and Söderström, U. (1999), "Monetary policy and market interest rates", working paper in Economics and Finance 242, Stockholm School of Economics.

Fuhrer, J.C. (1996), "Monetary policy shifts and long-term interest rates", *Quarterly Journal of Economics*, pp. 1183-209.

Leiderman, L. and Svensson, L. (1995), *Inflation Targets*, CEPR, London.

McCallum, B.T. (1983), "On the non-uniqueness in rational expectations models: an attempt at perspective", *Journal of Monetary Economics*, Vol. 11, pp. 139-68.

McCallum, B.T. (1994), "Monetary policy and the term structure of interest rates", NBER Working Paper 4938.

Roberts, J.M. (1995), "New Keynesian economics and the Phillips curve", *Journal of Money Credit and Banking*, Vol. 27, pp. 975-84.

Rotemberg, J. (1982), "Sticky prices in the United States", *Journal of Political Economy*, Vol. 60, pp. 1187-211.

Rudebusch, G.D. (1995), "Federal reserve interest rate targeting, rational expectations, and the term structure", *Journal of Monetary Economics*, Vol. 35, pp. 245-74.

Rudebusch, G.D. and Svensson, L.E.O. (1999), "Policy rules for inflation targeting", in Taylor, J.B. (Ed.), *Monetary Policy Rules*, University of Chicago Press, Chicago, IL.

Svensson, L.E.O. (1997), "Inflation forecast targeting: implementing and monitoring inflation targets", *European Economic Review*, Vol. 41, pp. 1111-46.

Svensson, L.E.O. (1999), "Inflation targeting as a monetary policy rule", *Journal of Monetary Economics*, Vol. 43, pp. 607-54.

Taylor, J.B. (1979), "Staggered contracts in a macro model", *American Economic Review*, Vol. 69, pp. 108-13.