

**Plan for today:**

Inflation Targeting (II)

1. Example of a dynamic modeling inflation targeting
2. The importance of inflation forecasts

Literature: Svensson (1997, *European Economic Review*).

Supplementary reading: Svensson (1999, 2000a,b).

**Introductory remarks**

- Potential problem of inflation targeting:
  - Inflation is only controllable with a “long and variable” lag
  - What constitutes target misses?
  - “Misconduct,” or shocks outside the bank’s control?
- Problem for monitoring and associated accountability => credibility problems
- Not a problem if target variable is closely controllable and readily verifiable
- Insurmountable problem?
- Not according to Svensson (1997):
  - Inflation targeting implies **inflation forecast targeting**
  - The inflation forecast is the **intermediate targeting variable**
  - It can become publicly known immediately, and form immediate basis for evaluation of policy performance
  - ....accountability and credibility restored
- When output fluctuations are of concern, one sees that the horizon for which inflation is expected to reach target increases
  - The definition of horizon length becomes proxy for output weight in central bank’s loss function

## Example of a dynamic modeling of inflation targeting: The role of inflation forecasts

- Simple AS/AD model with **control lags**:
  - Monetary policy (interest rate setting) affects demand with a one-period lag (say a year)
  - Demand affects inflation with a one-period lag (say a year)
  - Two year control lag from policy to inflation
  - Captures realism and lack of controllability:
    - \* Inflation today is result of various shocks having hit the economy over the past years AND monetary policy two years back
    - \* => Inflation today says NOTHING about the quality of current monetary policy
    - \* => No basis of using current inflation as a measure of the success of the inflation targeting regime
- What then?
  - The relevant measure of the “success” of current policy is whether inflation is **expected** to hit the target **at the control lag horizon**
  - (...assuming inflation is all that matters for policy...)

- The model (excluding the exogenous variable  $x_t$ ):

$$\pi_{t+2} = \pi_{t+1} + \alpha_1 y_{t+1} + \epsilon_{t+2} \quad (2.1')$$

$$y_{t+1} = \beta_1 y_t - \beta_2 (i_t - \pi_t) + \eta_{t+1} \quad (2.2')$$

$$\begin{aligned} \alpha_1 &> 0 \\ 0 &< \beta_1 < 1 \\ \beta_2 &> 0 \end{aligned}$$

- Exclusive aim of monetary policy: Attain the inflation target  $\pi^*$
- Modelled as minimization of

$$E_t \sum_{\tau=t}^{\infty} \delta^{\tau-t} L(\pi_{\tau}), \quad 0 < \delta < 1, \quad (2.4)$$

$$L(\pi_{\tau}) \equiv \frac{1}{2} (\pi_{\tau} - \pi^*)^2$$

- “Strict inflation targeting” — not realistic; cf. last lectures, but to make things simple for the moment
- Solution for inflation controllable by  $i_t$ :

$$\begin{aligned} \pi_{t+2} &= [\pi_t + \alpha_1 y_t + \epsilon_{t+1}] + \alpha_1 y_{t+1} + \epsilon_{t+2} \\ &= [\pi_t + \alpha_1 y_t + \epsilon_{t+1}] + \alpha_1 [\beta_1 y_t - \beta_2 (i_t - \pi_t) + \eta_{t+1}] + \epsilon_{t+2} \\ &= \alpha_1 \pi_t + \alpha_2 y_t - \alpha_4 i_t + (\epsilon_{t+2} + \epsilon_{t+1} + \alpha_1 \eta_{t+1}) \end{aligned} \quad (2.6')$$

- Solution to policy problem
- Choose sequence of interest rates that minimizes the intertemporal loss function
- A series of one-period problems:
  - $i_t$  affects  $\pi_{t+2}$  and inflation onwards;  $i_{t+1}$  affects  $\pi_{t+3}$  and onwards; etc.
  - $i_t$  should then make  $\pi_{t+2} = \pi^*$  in expectation;  $i_{t+1}$  should then make  $\pi_{t+3} = \pi^*$  in expectation; etc.
- Solve
 
$$\min_{i_t} E_t \delta^2 L(\pi_{t+2})$$
 subject to (2.6')
- First-order condition:
 
$$\frac{\partial E_t \delta^2 L(\pi_{t+2})}{\partial i_t} = -E_t \delta^2 a_4 (\pi_{t+2} - \pi^*) = 0$$
- Simple solution:
 
$$E_t \pi_{t+2} = \pi^*$$
 or in alternative notation:
 
$$\pi_{t+2|t} = \pi^* \quad (2.9)$$
- The interest rate is set such that the period  $t$  two-period ahead inflation forecast equals the inflation target

- A policy problem that yields the same result:
 
$$\min_{i_t} \delta^2 L^i(\pi_{t+2|t})$$

$$L^i \equiv \frac{1}{2} (\pi_{t+2|t} - \pi^*)^2$$
- Hence, inflation targeting is equivalent of **inflation forecast targeting**
  - This is intermediate targeting, with the inflation forecast being the intermediate target
- Implied instrument setting:
 
$$\hat{i}_t = \pi_t + b_1 (\pi_t - \pi^*) + b_2 y_t \quad (2.13')$$
- Same form as a Taylor rule
- Note: The variables in the instrument rule **are not those being targeted!!!!** But they help predict the target variable:  $\pi_{t+2|t}$
- Simple policy prescription underlying this:
  - If  $\pi_{t+2|t} > \pi^*$ , increase the interest rate
  - If  $\pi_{t+2|t} < \pi^*$ , lower the interest rate

- Note that due to shocks arriving after policy implementation, actual inflation in period  $t + 2$  will deviate from the inflation target
- One has:
 
$$\pi_{t+2} = \pi^* + (\epsilon_{t+2} + \epsilon_{t+1} + \alpha_1 \eta_{t+1}) \quad (2.15')$$
 I.e., deviations from target due to shocks occurring within the control lag
- These are **forecasting errors**, and should, of course, be kept at a minimum
- Here, they “are what they are,” so by construction **the forecasting error variance is minimal**
- The central bank, however, should be judged on its ability of attaining  $\pi_{t+2|t} = \pi^*$ , rather than  $\pi_{t+2} = \pi^*$ , which is inherently impossible
- So, monitor the forecasts and see if they are in line with the inflation target given the lags in policy transmission. I.e., implement **transparency**
- Other intermediate targets can — at best — only be as good as inflation forecast targeting (e.g., money growth forecast targeting)

### Monitoring with private goals

- In the above analysis there is no need for monitoring the central bank — it does a good job
- Monitoring is generally thought to improve accountability and credibility
  - Model is amended so as to create a role for monitoring
  - The central bank is assumed to have an **implicit time-varying** inflation target  $\pi_t^b$ ; e.g., in order to capture occasional incentives for pushing output above the natural rate (cf. a Barro and Gordon story)

- Formally, the central bank’s per-period loss function is

$$L_t^b(\pi_t) = \frac{1}{2} (\pi_t - \pi_t^b)^2 \quad (3.1)$$

$$\pi_t^b = \pi^* + z_t \quad (3.2)$$

$$z_{t+1} = (1 - \rho) \tilde{z} + \rho z_t + \xi_{t+1}, \quad 0 < \rho < 1, \quad (3.3)$$

- So, if  $\tilde{z} > 0$  the central bank has a higher inflation target on average than what is assigned
- Economic model is the same
- Central bank’s choice of interest rate is guided by first-order condition
 
$$-\delta^2 a_4 (\pi_{t+2|t} - \pi^* - z_{t+2|t}) = 0$$
 and thus
 
$$\pi_{t+2|t} = \pi^* + (1 - \rho^2) \tilde{z} + \rho^2 z_t \quad (3.5)$$

- Corresponding period  $t$  interest rate and actual period  $t + 2$  inflation:

$$i_t = \pi_t + b_1 (\pi_t - \pi^* - (1 - \rho^2) \tilde{z} - \rho^2 z_t) + b_2 y_t \quad (3.6')$$

$$\pi_{t+2} = \pi^* + (1 - \rho^2) \tilde{z} + \rho^2 z_t + (\epsilon_{t+2} + \epsilon_{t+1} + \alpha_1 \eta_{t+1}) \quad (3.7')$$

E.g., if  $z_t > 0$  the **interest rate** will be **lower** and **inflation** two periods ahead be **higher** than socially optimal

- Will **monitoring of the central bank** secure that this will not occur???
- In principle yes!
- Even if  $\pi^b$  is private information, the public observes  $i_t$ ,  $\pi_t$ , and  $y_t$  and can infer  $(1 - \rho^2) \tilde{z} + \rho^2 z_t$
- The public can also form  $\pi_{t+2|t}$  and see how it deviates from  $\pi^*$  when  $(1 - \rho^2) \tilde{z} + \rho^2 z_t \neq 0$

- I.e., the private sector can monitor a deviation in policymaking that compromises the inflation target  $\pi^*$
- This can give rise to public criticism, firing of the governor(s); etc.

- Modelled by adding a loss from deviation of the inflation forecast from  $\pi^*$ :

$$\varphi L^i (\pi_{t+2|t}), \quad \varphi > 0.$$

- Central bank's first-order condition is thus

$$-\delta^2 a_4 (\pi_{t+2|t} - \pi^* - (1 - \rho^2) \tilde{z} - \rho^2 z_t) - \varphi a_4 (\pi_{t+2|t} - \pi^*) = 0$$

and the forecast is

$$\pi_{t+2|t} = \pi^* + \frac{(1 - \rho^2) \tilde{z} + \rho^2 z_t}{1 + \varphi / \delta^2}$$

- If a high  $\varphi$  can be imposed, the solution approaches the socially optimal
  - Note analogy with Walsh-contacts and Rogoff-conservativeness
  - The central bank's incentives are being shaped so as to induce better policymaking

## “Strict” versus “flexible” inflation targeting

- The result  $\pi_{t+2|t} = \pi^*$  follows easily from the assumed “strict” inflation targeting
- More realistic, inflation targeting is “flexible,” i.e., output gap fluctuations are also considered costly

- Per-period loss function:

$$L(\pi_t, y_t) = \frac{1}{2} [(\pi_t - \pi^*)^2 + \lambda y_t^2],$$

$\lambda > 0$  is proxy for flexibility

- Optimal monetary policy is characterized by (use dynamic programming) variant of familiar first-order condition:

$$\pi_{t+2|t} - \pi^* = -\frac{\lambda}{\delta \alpha_1 k} y_{t+1|t} \quad (6.6)$$

with  $k \geq 1$

- Conventional “leaning-against-the-wind” condition
  - If output is expected to contract at the control horizon (one period), the interest rate is set so as to allow for an overshooting of inflation target
  - The higher  $\lambda$ , the higher overshooting
- Implication: The higher  $\lambda$ , **the longer time before inflation returns to target** in expectation

- Alternative exposition:
- From Phillips curve:

$$\pi_{t+2} = \pi_{t+1} + \alpha_1 y_{t+1} + \epsilon_{t+2}$$

$$\pi_{t+2|t} = \pi_{t+1|t} + \alpha_1 y_{t+1|t}$$

- Use first-order condition to eliminate  $y_{t+1|t}$  :

$$\pi_{t+2|t} = \pi_{t+1|t} - \frac{\delta \alpha_1^2 k}{\lambda} (\pi_{t+2|t} - \pi^*)$$

and thus

$$\pi_{t+2|t} - \pi^* = \pi_{t+1|t} - \pi^* - \frac{\delta \alpha_1^2 k}{\lambda} (\pi_{t+2|t} - \pi^*)$$

$$\pi_{t+2|t} - \pi^* = c (\pi_{t+1|t} - \pi^*) \quad (6.8)$$

$$0 < c \equiv \frac{\lambda}{\lambda + \delta \alpha_1^2 k} < 1$$

- Hence,  $\lambda > 0$  implies a **gradual return** of the inflation forecast to target
- Higher  $\lambda$ , higher  $c$  and thus slower return

## Concluding remarks

- Bands around inflation target?
  - Necessary if accountability is based on actual inflation
  - Should be proportional to forecast errors....
  - ...and thus widened when output stability is an objective
- Target rules versus instrument rules
  - Target rule:  $\pi_{t+2t} = \pi^*$
  - Instrument rule:  $i_t = \pi_t + b_1(\pi_t - \pi^*) + b_2y_t$
  - The former much simpler and requires less information (holds also in case of output objective)
- Svensson's conclusion: Accountability can be attained and credibility secured by transparency and inflation forecast targeting
  - Lack of controllability of actual inflation not particular problem for the performance of inflation targeting
  - Openness about the inflation forecast and bands around the target can remedy the difficulties of accountability

## Plan for next lecture

- (Final) Lectures, Monday, May 24:  
Transparency of Monetary Policymaking
1. A formal model of the effects of transparency
  2. Pros and cons of transparency
- Literature: Jensen (2002, *Scandinavian Journal of Economics*).  
Supplementary reading: Faust and Svensson (2001); Geraats (2002).