Monetary Policy

Chapter 3 examines the conditions needed for monetary policy to ensure a unique equilibrium. It also quantifies the effects of monetary policy for an empirically plausible calibration. But it stops short of saying what monetary policy is best. This is the goal of Chapter 4, as well as to look at other types of monetary policy rules:

Throughout this chapter, *optimal monetary policy* is that which maximizes the utility of the representative household. We solve for such a policy by first solving the social planner's problem:

$$Max_{C_t, N_t} \;\; u(C_t, N_t) \tag{1}$$

s.t.

$$C_t(i) = A_t N_t(i)^{1-\alpha} \tag{2}$$

$$N_t = \int_0^1 N_t(i) di \tag{3}$$

$$C_t = \left(\int_0^1 C_t(i)^{1-\frac{1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}} \tag{4}$$

Notice that the social planner's problem is very simple. Because there are no backwards looking equations, the problem is entirely static in that it depends on neither expectations of the future or past variables. Keep in mind that the social planner does not care about prices and the Calvo mechanism is thus not relevant to its problem.

Optimization yields three first-order conditions:

$$C_t(i) = C(t) \;\; \forall i \tag{5}$$

$$N_t(i) = N(t) \;\; \forall i \tag{6}$$

$$\frac{-U_{n,t}}{U_{c,t}} = MPN_t \tag{7}$$

Distortions in the New Keynesian Model

There are two distortions from complete and competitive markets that cause equilibrium in the NK model to differ from the social planner's problem. The first is monopolistic competition. To isolate this distortion, assume that prices are flexible so that $\theta = 0$. From Chapter 3, it follows that the firm's price setting problem yields:

$$P_t = \frac{\epsilon}{\epsilon - 1}\frac{W_t}{MPN_t} \tag{8}$$

where under flexible prices, $P_t = P_t^*$. Equation (8) may be re-written as:

$$\frac{W_t}{P_t} = \frac{\epsilon - 1}{\epsilon} MPN_t \tag{9}$$

Combining (7), (9) and the household's labor supply equation (from Chapter 2) yields:

$$\frac{-U_{n,t}}{U_{c,t}} = \frac{W_t}{P_t} = \frac{\epsilon - 1}{\epsilon} MPN_t < MPN_t \tag{10}$$

Equation (10) shows that unless $\epsilon \to \infty$, firms exploit their market power by producing too little output and thus employing too little labor. In theory, this distortion may be eliminated by incentivizing labor demand through a properly designed employment subsidy, denoted τ. With such a subsidy, the firms labor demand equation becomes:

$$P_t = \frac{\epsilon}{\epsilon - 1}\frac{(1-\tau)W_t}{MPN_t} label11 \tag{11}$$

or

$$\frac{W_t}{P_t} = \frac{\epsilon - 1}{\epsilon}\frac{MPN_t}{1-\tau} \tag{12}$$

It is then straightforward to solve for $\tau = \epsilon^{-1}$. The intuition is straightforward. Market power causes firms to limit production. An employment subsidy has the opposite effect and may thus induce firms to act as they would under perfect competition. A labor tax is the opposite of such a policy. We may thus interpret the model as supporting low labor taxes in general.

Although such a subsidy is obviously unrealistic, we assume it for the remainder of the chapter in order to isolate the effects of sticky prices.

We will isolate the policy that eliminates the effects of sticky prices through an argument.

Suppose that it were ever the case that, $\frac{P_t(i)}{P_t(j)} \neq 1$. Clearly the representative household would then choose $\frac{C_t(i)}{C_t(j)} \neq 1$ for any *epsilon* > 1 (which rules out the case of min-max preferences). Likewise, such an allocation requires that $\frac{N_t(i)}{N_t(j)} \neq 1$.

Examination of (2) and (3), however, reveals that such an allocation is suboptimal due to the concavity of both the production and utility functions.

Suppose that the economy starts at an allocation where $\frac{P_t(i)}{P_t(j)} = 1$ for any i and j. In this case, a policy that results in $\pi_t = 0, \forall\, t$ would preserve such an allocation indefinitely. In words, if prices are constant, it makes no difference whether or not you are visited by the Calvo Fairy.

Recall the New Keynesian Phillips Curve:

$$\pi_t = \beta E_t[\pi_{t+1}] + \kappa \tilde{y}_t \tag{13}$$

If inflation always equals zero then so will its rational expectation. It follows that $\tilde{y}_t = 0$.

Recall the Dynamic IS Equation from Chapter 3:

$$\tilde{y}_t = E_t[\tilde{y}_{t+1}] - \sigma^{-1}(i_t - E_t[\pi_{t+1}] - r_t^n) \tag{14}$$

It then follows that $i_t = r_t^n$.

A few comments about these results:

1. It is not optimal to stabilize y_t. The monetary authority should instead allow output to track changes in its natural rate. Suppose, for example, that higher energy prices (or any other decline in TFP) cause the natural rate of output to fall. The monetary authority should not try to reverse these effects.

2. By stabilizing π_t, the monetary authority also stabilizes $\tilde{y}_t$, a result sometimes called *divine coincidence.*

3. The result that $\pi_t = 0$ is optimal assumes that the economy begins at a point where there are no relative price distortions. If there are, then optimal policy converges toward $\pi_t = 0$. This must be shown numerically.

Implementation

It is not sensible for the monetary authority to employ a rule where $i_t = r_t^n$. Such a policy does not satisfy the Taylor Condition and the optimal allocation is just one of multiple equilibria that exist. Suppose instead that the monetary authority uses the following rule:

$$i_t = r_t^n + \phi_\pi \pi_t + \phi_y \tilde{y}_t \tag{15}$$

The model may then be written as:

$$\begin{bmatrix} \tilde{y}_t \\ \pi_t \end{bmatrix} = \frac{1}{\sigma + \phi_y + \kappa\phi_\pi} \begin{bmatrix} \sigma & 1 - \beta\phi_\pi \\ \sigma\kappa & \kappa + \beta(\sigma + \phi_y) \end{bmatrix} \begin{bmatrix} E_t[\tilde{y}_{t+1}] \\ E_t[\pi_{t+1}] \end{bmatrix} \tag{16}$$

This rule eliminates the error term that otherwise appears in the model. Recall from Chapter 3 that the Taylor Condition is:

$$\kappa(\phi_\pi - 1) + (1 - \beta)\phi_y > 0 \tag{17}$$

Without an error term, a policy rule that satisfies the Taylor Conditions yield two saddle conditions where $Z_{i,t} = 0$. It follows that $\pi_t = \tilde{y}_t$, which is the optimal allocation. Thus any rule that satisfies the Taylor Condition is optimal.

Informational Limitations

The policy rule, (15), imposes two severe informational requirements on the monetary authority. The first is that it is able to observe the current rates of inflation and the output gap. Suppose that it cannot and instead must rely on the following rule:

$$i_t = r_t^n + \phi_\pi E_t[\pi_{t+1}] + \phi_y E_t[\tilde{y}_{t+1}] \tag{18}$$

The model may now be written as follows:

$$\begin{bmatrix} \tilde{y}_t \\ \pi_t \end{bmatrix} = \begin{bmatrix} 1 - \sigma^{-1}\phi_y & -\sigma\phi_\pi \\ \kappa(1 - \sigma^{-1}\phi_y) & \beta - \kappa\sigma^{-1}\phi_\pi \end{bmatrix} \begin{bmatrix} E_t[\tilde{y}_{t+1}] \\ E_t[\pi_{t+1}] \end{bmatrix} \tag{19}$$

Determinacy again requires that both eigenvalues have modulus less than one:

Graph:

Once again, the morale of the story is that the monetary authority should be hawkish on inflation. But now, it is possible to bee "too hawkish." It is likewise important not to overreact to the output gap. As before, any policy ensuring determinacy yields the optimal allocation.

The second informational requirement is that the monetary authority be able to observe r_t^n and $\tilde{y}_t^n$. This is potentially problematic as both variables are hypothetical values that would exist under flexible prices. Suppose that the monetary authority cannot observe them. We assume that they may follow the alternative "second best" policy rule:

$$i_t = \rho + \phi_\pi \pi_t + \phi_y \hat{y}_t \tag{20}$$

where $haty_t = y_t - \bar{y}$ where $bary$ is the average value of output. Using $\tilde{y}_t = y_t - y_t^n$, we can write the model as:

$$\begin{bmatrix} \tilde{y}_t \\ \pi_t \end{bmatrix} = \frac{1}{\sigma + \phi_y + \kappa\phi_\pi} \begin{bmatrix} \sigma & 1 - \beta\phi_\pi \\ \sigma\kappa & \kappa + \beta(\sigma + \phi_y) \end{bmatrix} \begin{bmatrix} E_t[\tilde{y}_{t+1}] \\ E_t[\pi_{t+1}] \end{bmatrix} + \begin{bmatrix} 1 \\ \kappa \end{bmatrix} (r_t^n - v_t) \tag{21}$$

where $v_t = \phi_y \tilde{y}_t$.

The analysis must be done numerically. The results show that a rule with a large value of ϕ_π and a small value of ϕ_y does best. Once again, it is best for the monetary authority to aggressively respond to inflation.