Monetary Economics: Problem Set #2

Due Thursday August 28th in class

This problem set is marked out of 100 points. The weight given to each part is indicated below. Please contact me asap if you have any questions.

1. **Inflation targeting with noisy data.** Consider a new Keynesian model with output gap and inflation dynamics governed by

$$\tilde{y}_t = -\frac{1}{\sigma}(i_t - \mathbb{E}_t\{\pi_{t+1}\} - r_t^n) + \mathbb{E}_t\{\tilde{y}_{t+1}\}$$

and

$$\pi_t = \beta \mathbb{E}_t\{\pi_{t+1}\} + \kappa \tilde{y}_t$$

where all variables have their usual meanings. The natural rate of interest follows an exogenous AR(1) process

$$r_{t+1}^n - \rho = \rho_r(r_t^n - \rho) + \epsilon_{t+1}$$

with $0 \leq \rho_r < 1$ and where $\{\epsilon_t\}$ is IID white noise with mean zero.

Now suppose that inflation is observed with *measurement error* so that the central bank sees only a noisy signal of actual inflation

$$\pi_t^0 = \pi_t + \xi_t$$

where π_t^0 denotes the observed inflation rate, π_t the actual inflation rate, and where $\{\xi_t\}$ is IID white noise with mean zero. Assume the central bank follows the feedback rule

$$i_t = \rho + \phi_\pi \pi_t^0 \tag{1}$$

in terms of observed inflation.

   (a) Use the method of undetermined coefficients to solve for the equilibrium processes for inflation and the output gap under the interest rate rule. (20 points)

   (b) Describe the behavior of inflation, the output gap, and the nominal interest rate when $\phi_\pi \to \infty$. Give economic intuition for your answers. (15 points)

To simplify the algebra, assume for the rest of this question that $\rho_r = 0$.

   (c) Determine the value of the feedback coefficient ϕ_π that minimises the variance of actual inflation. Give economic intuition for your answer. (15 points)

2. **Monetary policy and the effects of productivity shocks.** Consider a new Keynesian model with equilibrium conditions

$$y_t = -\frac{1}{\sigma}(i_t - \mathbb{E}_t\{\pi_{t+1}\} - \rho) + \mathbb{E}_t\{y_{t+1}\} \tag{2}$$

and

$$\pi_t = \beta\mathbb{E}_t\{\pi_{t+1}\} + \kappa(y_t - y_t^n) \tag{3}$$

where all variables have their usual meanings. Monetary policy is given by the feedback rule

$$i_t = \rho + \phi_\pi \pi_t$$

where $\phi_\pi > 1$. The production function (in logs) is

$$y_t = a_t + n_t$$

where a_t is an exogenous labor productivity process that follows an AR(1) process

$$a_{t+1} = \rho_a a_t + \epsilon_{t+1}$$

with $0 \leq \rho_a < 1$ and where $\{\epsilon_t\}$ is IID white noise with mean zero. Natural output is proportional to productivity

$$y_t^n = \psi_y a_t$$

where $\psi_y > 0$.

(a) Describe in words the economic interpretation of equations (2) and (3). (10 points)

(b) Use the method of undetermined coefficients to solve for the equilibrium response of output, employment, and inflation to a productivity shock. (20 points)

(c) Describe how these responses depend on the values of the parameters ϕ_π and κ. What happens when $\phi_\pi \to \infty$? What happens as the degree of price rigidities changes? Provide economic intuition for your answers. (10 points)

(d) Discuss with as much detail as you can the joint response of employment and output to a productivity shock and discuss the implications for assessing the role of productivity shocks as a source of business cycle fluctuations in this model. (10 points)

Hint: you may want to skim Gali's 1999 paper "Technology, Employment, and the Business Cycle: Do Technology Shocks Explain Aggregate Fluctuations?" (posted on the LMS).