ECON4325 - Spring 2020

The exam consists of three parts: A, B, and C. In the grading, part A is given 10 % weight, part B is given 30 % weight, and part C is given 60 % weight.

Part A (10 %)

The first-order conditions of the firm problem with sticky prices can be combined to

$$\sum_{k=0}^{\infty} \theta^k E_t \left\{ \Delta_{t,t+k} Y_{t+k|t} \left[P_t^* - \mathcal{M} \Psi_{t+k|t} \right] \right\} = 0 \tag{1}$$

where $\Delta_{t,t+k} = \beta^k \frac{U_{c,t+k}}{U_{c,t}} \frac{P_t}{P_{t+k}}$, θ is the Calvo probability (not change prices), $Y_{t+k|t}$ is the production of a firm in period $t+k$ that last reset its price in period t, P_t^* is the optimal price in period t, $\mathcal{M}$ is the desired mark-up, and $\Psi_{t+k|t}$ is nominal marginal cost in period $t+k$ for a firm that last reset its price in period t. Interpret equation (1). What does the firms take into considerations when setting prices?

Part B (30 %)

A large, negative shock to the natural rate of interest has brought the policy rate to 0, while inflation and output remains below target.

a) Outline and *briefly* discuss what types of measures the central bank can implement to provide further stimulus.

b) Suppose the central bank contemplates using its balance sheet as a tool for further stimulus. Discuss the main types of balance sheet operations and under which economic conditions they are suitable.

c) Suppose the central bank contemplates setting the policy rate to a negative number. Sketch a model of the bank lending channel of negative monetary policy rates when banks fund themselves with deposits and an alternative funding source, and there is a zero lower bound on deposit rates. Discuss the conditions which determine the strength of the bank lending channel of negative policy rates.

Part C (60 %)

We are going to use the New Keynesian model to see how the economy responds to a cost-push shock under an interest rate rule. We assume that the model is

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa \tilde{y}_t + u_t \tag{2}$$

$$\tilde{y}_t = E_t\{\tilde{y}_{t+1}\} - \frac{1}{\sigma}\left(i_t - E_t\{\pi_{t+1}\} - \rho\right) \tag{3}$$

$$i_t = \phi_\pi \pi_t + \phi_y \tilde{y}_t + \rho \tag{4}$$

$$u_t = \rho_u u_{t-1} + \epsilon_t^u \tag{5}$$

$$\epsilon_t^u \sim N(0, \sigma_u) \tag{6}$$

$$\kappa = \left(\sigma + \frac{\phi + \alpha}{1-\alpha}\right)\left(\frac{1-\theta}{\theta}\right)(1-\beta\theta)\left(\frac{1-\alpha}{1-\alpha+\alpha\epsilon}\right) \tag{7}$$

a) Insert (4) into (3) and guess that

$$\begin{aligned}
\tilde{y}_t &= \psi_{yu} u_t \\
\pi_t &= \psi_{\pi u} u_t \\
E_t\{\tilde{y}_{t+1}\} &= \rho_u \psi_{yu} u_t \\
E_t\{\pi_{t+1}\} &= \rho_u \psi_{\pi u} u_t.
\end{aligned}$$

Solve the equation system and show that

$$\psi_{yu} = -(\phi_\pi - \rho_u)\Lambda_u \tag{8}$$

$$\psi_{\pi u} = (\sigma(1-\rho_u) + \phi_y)\Lambda_u \tag{9}$$

$$\Lambda_u = \frac{1}{(1-\beta\rho_u)(\sigma(1-\rho_u)+\phi_y) + \kappa(\phi_\pi - \rho_u)}. \tag{10}$$

b) Figure 1 shows the impulse responses of the output gap, inflation, the nominal interest rate, and the cost push shock to an initial shock to ϵ_0^u of 0.25. We have used the following calibration: $\beta = 0.99$, $\sigma = 1$, $\phi = 5$, $\alpha = 0.25$, $\epsilon = 9$, $\theta = 0.75$, $\phi_\pi = 1.5$, $\phi_y = 0$, and $\rho_u = 0$. Explain why the cost push shock affects the economy the way it does in Figure 1.

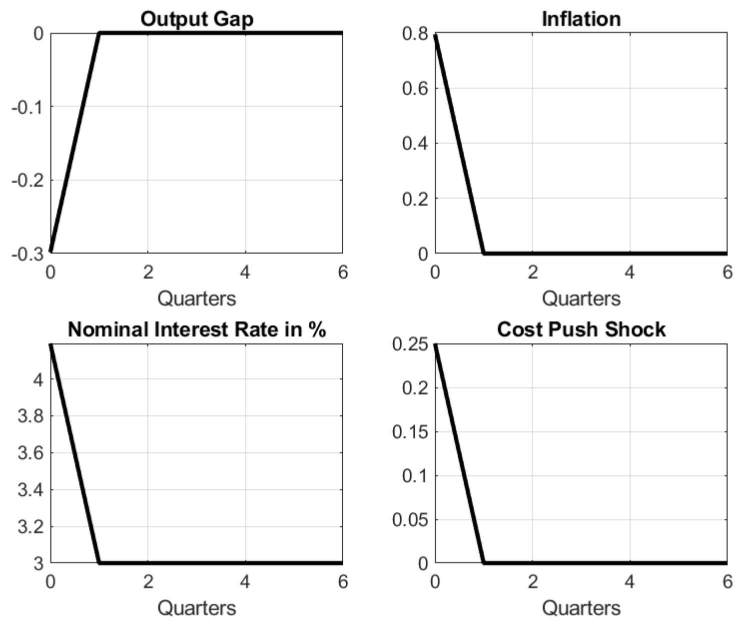

Figure 1: Impulse responses to a cost push shock

c) We now change the calibration by increasing ϕ from 5 to 30. All other parameters are the same as in problem b. Figure 2 presents the impulse responses in the benchmark scenario and in the new calibration. Explain what ϕ is, how it changes the economic environment, and explain how agents alter their behavior. Next, explain why the aggregate responses of the economy change in the way presented in Figure 2.

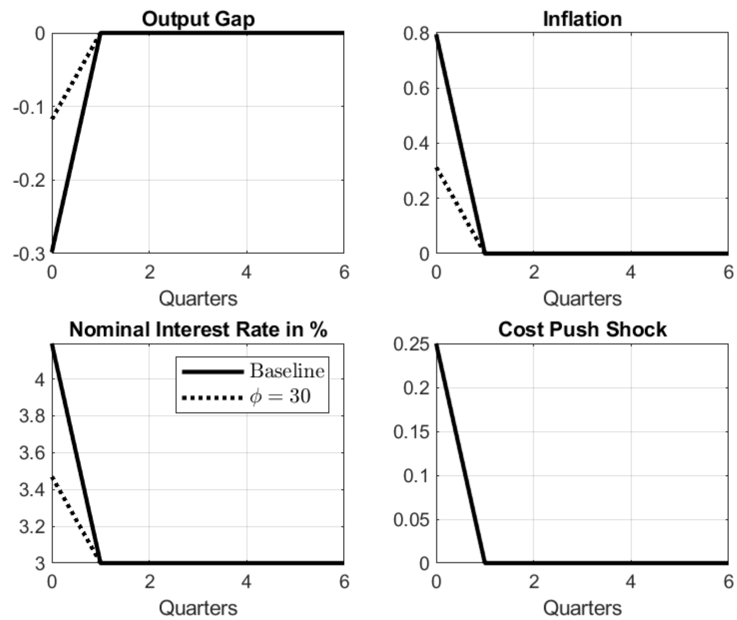

Figure 2: Impulse responses to a cost push shock: variation in ϵ

d) Assume now that the central bank follows optimal monetary policy instead of a Taylor rule (4). The loss function is

$$L_t = \frac{1}{2}\sum_{k=0}^{\infty}\beta^k\left(\lambda\tilde{y}_{t+k}^2 + \pi_{t+k}^2\right)$$

Show that the solution for optimal monetary policy under discretion is

$$\pi_t = \frac{\lambda}{\lambda + \kappa^2}u_t \tag{11}$$

$$\tilde{y}_t = -\frac{\kappa}{\lambda + \kappa^2}u_t \tag{12}$$

$$\lambda\tilde{y}_t = -\kappa\pi_t \tag{13}$$

e) Interpret equation (13). What trade-off does the central bank face?

f) Figure 3 presents the impulse responses from b) (Taylor Rule) and the responses under optimal monetary policy. Should we put more or less (relative) weight on output in the Taylor rule to get closer to the optimal monetary policy?

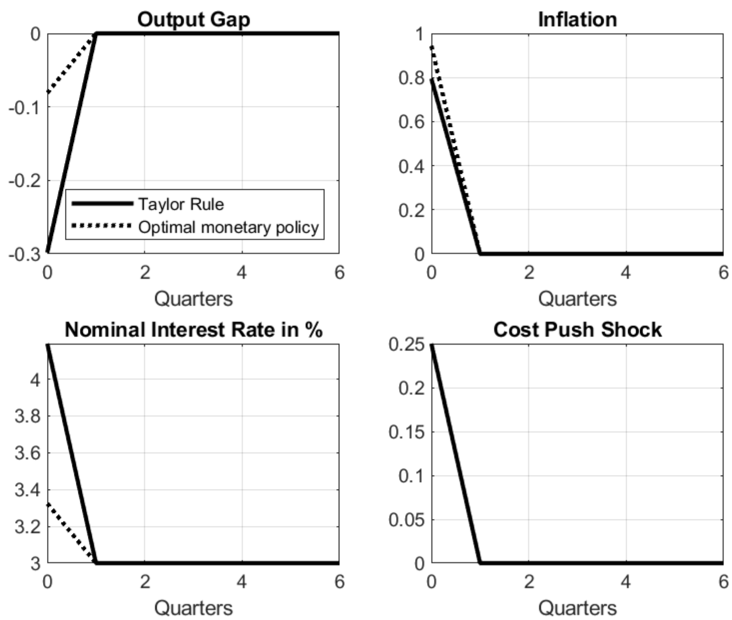

Figure 3: Impulse responses to a cost push shock: including first-order condition from optimal monetary policy

g) Optimal monetary policy can in this model be implemented as a Taylor rule with an updated coefficient $\hat{\phi}_y$. Use the solutions you found in problem a) and d) to show that one way to implement optimal monetary policy is to adopt a Taylor rule with

$$\hat{\phi}_y = \frac{\lambda\phi_\pi - \kappa\sigma}{\kappa}$$

for any ϕ_π.