The exam consists of three parts: A, B, and C. In the grading, part A is given 25 % weight, part B is given 25 % weight, and part C is given 50 % weight.

Part A (25 %)

a) Suppose you are an advisor at the central bank. The output gap is negative and inflation is below target. At the same time, the interest rate is zero and the central bank is unwilling to lower the interest rate further (negative interest rates should not be considered). Describe which policies are available to the central bank and argue for what the central bank should do using theory and empirical results.

b) In the standard New Keynesian model presented on lecture 2, 3, and 4, there is a representative household that has a very small marginal propensity to consume (around 0.05). Suppose instead that the average marginal propensity to consume among households is 0.50 rather than 0.05. Discuss how such a change in the average marginal propensity to consume affects how monetary policy transmits to aggregate consumption.

Part B (25 %)

We assume that households choose to purchases various goods. The households maximizes the aggregate consumption good subject to a given expenditure level. The problem can be formulated as

$$\max_{C_t(i)} \left(\int_0^1 C_t(i)^{1-\eta} di \right)^{\frac{1}{1-\eta}}$$

subject to

$$X_t = \int_0^1 P_t(i) C_t(i) di$$

a) Show that the demand for good i is

$$C_t(i) = \left(\frac{P_t(i)}{P_t} \right)^{-1/\eta} C_t$$

where $P_t = \left(\int_0^1 P_t(i)^{1-1/\eta} di \right)^{\frac{1}{1-1/\eta}}$.

b) Interpret η as an elasticity. What happens when $\eta \to 0$ and $\eta \to \infty$?

c) We assume that firms maximize profits. The firm problem can then be expressed as

$$\max_{P_t(i)} P_t(i)Y_t(i) - W_t N_t(i)$$
$$\text{subject to}$$
$$Y_t(i) = N_t(i)$$
$$Y_t(i) = \left(\frac{P_t(i)}{P_t}\right)^{-1/\eta} Y_t.$$

Solve for the optimal price and interpret.

Part C (50 %)

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

$$\pi_t = E_t\{\pi_{t+1}\} + \kappa x_t + u_t \tag{1}$$
$$x_t = E_t\{x_{t+1}\} - (i_t - E_t\{\pi_{t+1}\}) \tag{2}$$
$$i_t = \phi_\pi \pi_t \tag{3}$$
$$u_t = \rho u_{t-1} + \varepsilon_t^u \tag{4}$$
$$\varepsilon_t^u \sim N(0, \sigma_u) \tag{5}$$
$$\kappa = \left(1 + \frac{\phi + \alpha}{1 - \alpha}\right)\left(\frac{1-\theta}{\theta}\right)(1-\theta)\left(\frac{1-\alpha}{1-\alpha+\alpha\varepsilon}\right) \tag{6}$$

where x is the output gap, π is inflation, i is the nominal interest rate, and u is cost-push shock. κ, ϕ_π, ρ, σ_u, ϕ, α, θ, and ε are known parameters.

a) Insert (3) into (2) and guess that

$$x_t = \psi_{xu} u_t$$
$$\pi_t = \psi_{\pi u} u_t$$
$$E_t\{x_{t+1}\} = \rho \psi_{xu} u_t$$
$$E_t\{\pi_{t+1}\} = \rho \psi_{\pi u} u_t.$$

Find the solutions for ψ_{xu} and $\psi_{\pi u}$.

b) Figure 1 shows the impulse responses of the output gap, inflation, the real interest rate, 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: $\phi = 5$, $\alpha = 0.25$, $\epsilon = 9$, $\theta = 0.75$, $\phi_\pi = 1.5$, and $\rho = 0.5$. Explain why the cost push shock affects the economy the way it does in Figure 1.

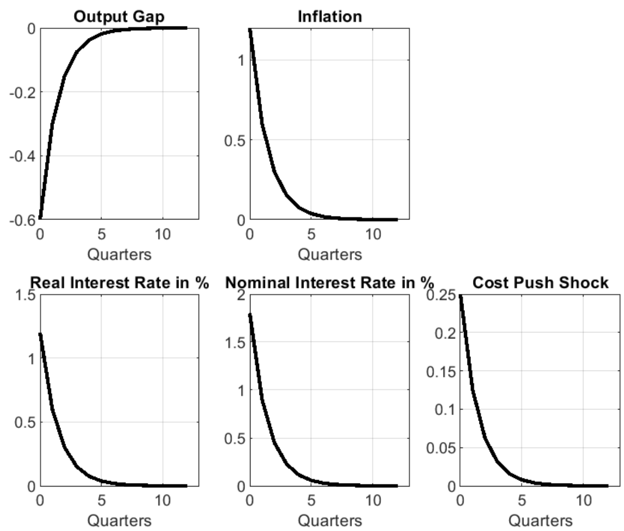

Figure 1: Impulse responses to a cost push shock

c) We now change the calibration by decreasing θ from 0.75 to 0.50. 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 θ is, how it changes the economic environment, and how agents alter their behavior. Next, explain why the aggregate responses of the economy change in the way presented in Figure 2.

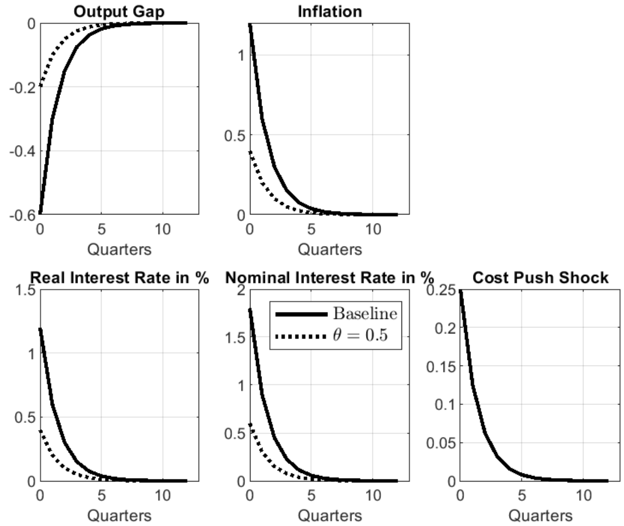

Figure 2: Impulse responses to a cost push shock: variation in θ.

d) Assume now that the central bank follows optimal monetary policy instead of a Taylor rule (3) where the central bank cares about inflation and having an interest rate close to the natural interest rate (which is zero here). The loss function is

$$L_t = \frac{1}{2}\sum_{k=0}^{\infty}\left(\pi_{t+k}^2 + \gamma i_{t+k}^2\right)$$

where $\gamma > 0$ is a parameter. Show that the solution for optimal monetary policy under discretion is

$$\gamma i_t = \kappa \pi_t. \tag{7}$$

e) Interpret equation (7). What trade-off does the central bank face?