NKM - SHORT REVIEW AND PRACTICE QUESTIONS

Discussion ECON 210C - Paula Donaldson

PLAN FOR TODAY

1. Short review of the New Keynesian Model
2. Practice question I
3. Practice question II

THREE-EQUATION NK MODEL

The log-linearized NK model boils down to three equations:

$$\text{D-IS:} \qquad \hat{y}_t = -\sigma[\hat{i}_t - E_t\{\hat{\pi}_{t+1}\}] + E_t\{\hat{y}_{t+1}\}$$

$$\text{NKPC:} \qquad \hat{\pi}_t = \kappa \underbrace{(\hat{y}_t - \hat{y}_t^{flex})}_{\text{Output Gap}} + \beta E_t\{\hat{\pi}_{t+1}\} + u_t$$

$$\text{MR:} \qquad \hat{i}_t = \phi_\pi \hat{\pi}_t + v_t$$

with

- three unknowns: $\hat{i}_t$, $\hat{y}_t$, and $\hat{\pi}_t$,
- productivity shocks drive the output gap $\hat{y}_t^{flex} = \frac{1+\varphi}{\gamma+\varphi} \hat{a}_t$,
- the monetary policy shock v_t.
- the cost push shock u_t

THREE-EQUATION NK MODEL - DYNAMIC IS

Dynamic IS: Relates output to future expectations of output and the real interest rate

1. Solve HH block for (non-linear) Euler:

$$1 = \beta E_t \left\{ (1 + i_t) \frac{P_t}{P_{t+1}} \frac{C_{t+1}^{-\gamma}}{C_t^{-\gamma}} \right\} = E_t\{\Lambda_{t,t+1} R_{t+1}\}$$

2. Log-linearize around zero-inflation steady state:

$$\hat{c}_t = -\frac{1}{\gamma} \left(\hat{i}_t - E_t\{\hat{\pi}_{t+1}\} \right) + E_t\{\hat{c}_{t+1}\}$$

3. Substitute with market clearing $Y = C$ and EIS $\sigma \equiv 1/\gamma$ (with iterated version):

$$\hat{y}_t = -\sigma \left(\hat{i}_t - E_t\{\hat{\pi}_{t+1}\} \right) + E_t\{\hat{y}_{t+1}\}$$

$$\Rightarrow \; \hat{y}_t = -\sigma E_t \left\{ \sum_{s=0}^{\infty} (\hat{r}_{t+s+1}) \right\}$$

THREE-EQUATION NK MODEL - NKPC

NKPC: inflation is expectations-augmented PDV of future marginal cost / markup deviations expressed in terms of output gap

1. Log-linearized price index (Dixit-Stiglitz + Calvo pricing)

$$P_t = \left[\theta P_{t-1}^{1-\epsilon} + (1-\theta) P_t^{*1-\epsilon}\right]^{\frac{1}{1-\epsilon}} \implies \hat{\pi}_t = (1-\theta)(\hat{p}_t^* - \hat{p}_{t-1})$$

2. Log-linearized reset price from firm problem written recursively

$$P_t^* = (1+\mu) E_t \left\{ \sum_{s=0}^{\infty} \frac{\theta^s \Lambda_{t,t+s} Y_{t+s} P_{t+s}^{\epsilon-1}}{\sum_{k=0}^{\infty} \theta^k \Lambda_{t,t+k} Y_{t+k} P_{t+k}^{\epsilon-1}} \frac{W_{t+s}}{A_{t+s}} \right\}$$

$$\implies \hat{p}_t^* = (1-\beta\theta)(\hat{p}_t + \hat{mc}_t) + \beta\theta E_t\{\hat{p}_{t+1}^*\}$$

3. Combine and iterate for inflation in terms of marginal cost deviation:

$$\hat{\pi}_t = \lambda \hat{mc}_t + \beta E_t\{\hat{\pi}_{t+1}\}, \quad \text{where } \lambda = \frac{(1-\theta)(1-\beta\theta)}{\theta}$$

$$\implies \hat{\pi}_t = \lambda E_t \left\{ \sum_{s=0}^{\infty} \beta^s \hat{mc}_{t+s} \right\}$$

RTHREE-EQUATION NK MODEL - NKPC CONT.

4. Define marginal cost deviation in terms of output gap: output less natural (i.e., flexible price) level of output

$(\gamma+\varphi)\hat{y}_t^{flex} = \varphi\hat{a}_t$

$$\underline{\hat{mc}_t} = \hat{w}_t - \hat{p}_t - \hat{a}_t = (\gamma + \varphi)\hat{y}_t - \varphi\hat{a}_t$$

$$\Rightarrow \quad (\gamma + \varphi)\hat{y}_t^{flex} \equiv \cancel{(\;\;+}\, \varphi)\hat{a}_t \quad \text{for } \hat{mc}_t^{flex} = 0$$

$$\Rightarrow \quad \hat{mc}_t = (\gamma + \varphi)(\hat{y}_t - \hat{y}_t^{flex})$$

5. Arrive at NKPC (with iterated version):

$$\hat{\pi}_t = \kappa(\hat{y}_t - \hat{y}_t^{flex}) + \beta E_t\{\hat{\pi}_{t+1}\} \quad \text{where} \quad \kappa = \lambda(\gamma + \varphi)$$

$$\Rightarrow \quad \hat{\pi}_t = \kappa E_t \left\{ \sum_{s=0}^{\infty} \beta^s (\hat{y}_{t+s} - \hat{y}_{t+s}^{flex}) \right\}$$

$\hat{mc}_t = (\gamma+\varphi)\hat{y}_t - \varphi\hat{a}_t$

$= (\gamma+\varphi)\hat{y}_t - (\gamma+\varphi)\hat{y}_t^{flex}$

$= (\gamma+\varphi)(\hat{y}_t - \hat{y}_t^{flex})$

THREE-EQUATION NK MODEL - MONETARY POLICY RULE

Central banks sets the nominal interest rate according to an interest rate (Taylor) rule

1. Log-linearized monetary rule:

$$\hat{i}_t = \phi_\pi \hat{\pi}_t + v_t$$

PRACTICE QUESTIONS

SPRING 2022 QUAL QUESTION

Consider the standard NK model with $\hat{y}_t^{flex}$ normalized to zero:

$$\hat{y}_t = -\sigma[\hat{i}_t - E_t\{\hat{\pi}_{t+1}\}] + E_t\{\hat{y}_{t+1}\}$$

$$\hat{\pi}_t = \kappa\hat{y}_t + \beta E_t\{\hat{\pi}_{t+1}\}$$

$$\hat{i}_t = \phi_\pi\hat{\pi}_t + v_t$$

- (a) **(20pts)** Assume $v_t = \rho_v v_{t-1} + \epsilon_t^v$ with $\epsilon_t^v \sim N(0, \sigma_v^2)$. Solve for the equilibrium levels of $\hat{y}_t, \hat{\pi}_t, \hat{i}_t$, and $\hat{r}_t = \hat{i}_t - \mathbb{E}_t\hat{\pi}_{t+1}$ as a function of v_t.
- (b) **(20pts)** Explain intuitively how a monetary policy shock affects the output, inflation, the nominal interest rate, and the real interest rate. (max 5 sentences)
- (c) **(15pts)** Briefly explain the identification problem in estimating the effect of monetary policy shocks on real output. (max 5 sentences)
- (d) **(30pts)** Briefly explain two approaches to solving the identification problem. (max 5 sentences each)

SPRING 2022 QUAL QUESTION

Consider the standard NK model with $\hat{y}_t^{flex}$ normalized to zero:

$$\hat{y}_t = -\sigma[\hat{i}_t - E_t\{\hat{\pi}_{t+1}\}] + E_t\{\hat{y}_{t+1}\} \qquad \text{D-IS}$$

$$\hat{\pi}_t = \kappa\hat{y}_t + \beta E_t\{\hat{\pi}_{t+1}\} \qquad \text{NKPC}$$

$$\hat{i}_t = \phi_\pi\hat{\pi}_t + v_t \qquad \text{MR}$$

(a) **(20pts)** Assume $v_t = \rho_v v_{t-1} + \epsilon_t^v$ with $\epsilon_t^v \sim N(0, \sigma_v^2)$. Solve for the equilibrium levels of $\hat{y}_t, \hat{\pi}_t, \hat{i}_t$, and $\hat{r}_t = \hat{i}_t - \mathbb{E}_t\hat{\pi}_{t+1}$ as a function of v_t.

Replace MR in D-IS:

$$\hat{y}_t = -\sigma\left[\phi_\pi\hat{\pi}_t + v_t - E_t\hat{\pi}_{t+1}\right] + E_t\hat{y}_{t+1}$$

$$\hat{y}_t = -\sigma\phi_\pi\hat{\pi}_t - \sigma v_t + \sigma E_t\hat{\pi}_{t+1} + E_t\hat{y}_{t+1}$$

+ NKPC

Guess:

$$\hat{y}_t = \Psi_y v_t$$

$$\hat{\pi}_t = \Psi_\pi v_t$$

AR(1) for v_t

$$v_t = \rho v_{t-1} + \epsilon^v_t$$

How to get $E_t[\hat{x}_{t+1}]$?

$$E_t[\hat{x}_{t+1}] = E_t[\Psi_x v_{t+1}]$$

$$= \Psi_x E_t[v_{t+1}]$$

$$= \Psi_x E_t[\rho v_t + \epsilon^v_{t+1}]$$

$$= \Psi_x \rho \underbrace{E_t[v_t]} + \underbrace{E_t[\epsilon^v_{t+1}]}_{0}$$

$$E_t[\hat{x}_{t+1}] = \Psi_x \rho v_t$$

$$\hat{\pi}_t = \kappa \hat{y}_t + \beta E_t[\hat{\pi}_{t+1}]$$

$$\Psi_\pi v_t = \kappa \Psi_y v_t + \beta \rho \Psi_\pi v_t$$

$$[\Psi_\pi - \kappa \Psi_y - \beta \rho \Psi_\pi] v_t = 0$$

$$(1 - \beta \rho) \Psi_\pi = \kappa \Psi_y$$

$$\boxed{\Psi_y = \frac{(1 - \beta \rho)}{\kappa} \Psi_\pi}$$

$$\hat{y}_t = -\sigma\phi_\pi \hat{\pi}_t - \sigma v_t + \sigma E_t \hat{\pi}_{t+1} + E_t \hat{y}_{t+1}$$

$$\Psi_y v_t = -\sigma\phi_\pi \Psi_\pi v_t - \sigma v_t + \sigma\rho\Psi_\pi v_t + \rho\Psi_y v_t$$

$$\left[\Psi_y + \sigma\phi_\pi\Psi_\pi + \sigma - \sigma\rho\Psi_\pi - \rho\Psi_y\right] v_t = 0$$

$$\Rightarrow (1-\rho)\Psi_y = \sigma(\rho - \phi_\pi)\Psi_\pi - \sigma$$

$$\boxed{\Psi_y = \frac{\sigma(\rho - \phi_\pi)}{(1-\rho)}\Psi_\pi - \frac{\sigma}{(1-\rho)}}$$

$$\frac{\sigma(\rho-\phi_\pi)}{(1-\rho)}\Psi_\pi - \frac{\sigma}{(1-\rho)} = \frac{(1-\beta\rho)}{\kappa}\Psi_\pi$$

$$\left[\frac{\sigma(\rho-\phi_\pi)}{(1-\rho)} - \frac{(1-\beta\rho)}{\kappa}\right]\Psi_\pi = \frac{\sigma}{1-\rho}$$

$$\frac{\sigma\kappa(\rho-\phi_\pi) - (1-\rho)(1-\beta\rho)}{(1-\rho)\kappa}\Psi_\pi = \frac{\sigma}{(1-\rho)}$$

$$\boxed{\Psi_\pi = \frac{\kappa\sigma}{\sigma\kappa(\rho-\phi_\pi) - (1-\rho)(1-\beta\rho)}}$$

$$\Psi_y = \frac{(1-\beta\rho)}{\cancel{\kappa}} \; \frac{\cancel{\kappa}\,\sigma}{\sigma\kappa(\rho-\phi_\pi)-(1-\rho)(1-\beta\rho)}$$

Eq. levels:

$$\hat{y}_t = \Psi_y v_t \; ; \; \hat{\pi}_t = \Psi_\pi v_t$$

$$\hat{i}_t = \phi_\pi \underbrace{\Psi_\pi v_t}_{\pi_t} + v_t = (1+\phi_\pi \Psi_\pi) v_t$$

$$\hat{r}_t = \hat{i}_t - E_t[\hat{\pi}_{t+1}]$$

$$= (1+\phi_\pi\Psi_\pi) v_t - \rho \Psi_\pi v_t$$

$$= (1+(\phi_\pi-\rho)\Psi_\pi) v_t$$

SPRING 2022 QUAL QUESTION

Consider the standard NK model with $\hat{y}_t^{flex}$ normalized to zero:

$$\hat{y}_t = -\sigma[\hat{i}_t - E_t\{\hat{\pi}_{t+1}\}] + E_t\{\hat{y}_{t+1}\}$$

$$\hat{\pi}_t = \kappa\hat{y}_t + \beta E_t\{\hat{\pi}_{t+1}\}$$

$$\hat{i}_t = \phi_\pi\hat{\pi}_t + v_t$$

a. **(20pts)** Explain intuitively how a monetary policy shock affects the output, inflation, the nominal interest rate, and the real interest rate. (max 5 sentences)

SPRING 2022 QUAL QUESTION

a. **(15pts)** Briefly explain the identification problem in estimating the effect of monetary policy shocks on real output. (max 5 sentences)

SPRING 2022 QUAL QUESTION

a. **(30pts)** Briefly explain two approaches to solving the identification problem. (max 5 sentences each)

NEW KEYNESIAN MODEL - PRACTICE QUESTION

1. Cost-push shocks

Consider the standard new Keynesian model $\sigma = 1$

$$\hat{x}_t = E_t\hat{x}_{t+1} \overset{\sigma}{-} E_t(\hat{i}_t - \hat{\pi}_{t+1} - \hat{r}^n_{t+1}) \tag{1}$$

$$\hat{\pi}_t = \beta E_t\hat{\pi}_{t+1} + \kappa\hat{x}_t + u_t \tag{2}$$

$$\hat{i}_t = \phi_\pi\hat{\pi}_t, \qquad \phi_\pi > 1 \tag{3}$$

(a) Interpret each of the equations (1)-(3) (max 2 sentence each).

(b) Assume $\hat{r}^n_t = 0$ and $u_t = \rho_u u_{t-1} + \epsilon^u_t$ with $\epsilon^u_t \sim N(0, \sigma^2_{\epsilon^u})$. Solve for the equilibrium levels of $\hat{x}_t$, $\hat{\pi}_t$, $\hat{i}_t$, and $\hat{r}_t = \hat{i}_t - E_t\hat{\pi}_{t+1}$ as a function of u_t.

(c) Explain intuitively how a supply shock affects the output gap, inflation, the nominal interest rate, and the real interest rate. (4 sentences should suffice.)

(d) Use your solution to express the loss function $L = \vartheta var(\hat{x}_t) + var(\hat{\pi}_t)$ as a function of the model parameters, where $var(\hat{x}_t)$ is the variance of the output gap and $var(\hat{\pi}_t)$ is the variance of inflation.

(e) Show that the optimal interest rate rule satisfies $\phi_\pi = \rho_u + \frac{\kappa(1-\rho_u)}{\vartheta(1-\beta\rho_u)}$.

(f) Using the optimal ϕ_π, show that $\hat{x}_t = -\frac{\kappa}{\vartheta(1-\beta\rho_u)}\hat{\pi}_t$.

(g) The optimal monetary policy under discretion is $\hat{x}_t = -\frac{\kappa}{\vartheta}\hat{\pi}_t$. Does the optimal ϕ_π deliver a better, a worse, or the same loss? Explain intuitively. (No derivation should be necessary.)

(a) Interpret each of the equations (1)-(3)

Guess:

$$\hat{x}_t = \Psi_x u_t$$

$$\hat{\pi}_t = \Psi_\pi u_t$$

$$\Psi_x = \frac{\rho_u - \phi_\pi}{(1-\beta\rho_u)(1-\rho_u) - \kappa(\rho_u - \phi_\pi)}$$

$$\Psi_\pi = \frac{1 - \rho_u}{(1-\beta\rho_u)(1-\rho_u) - \kappa(\rho_u - \phi_\pi)}$$

(b) Assume $\hat{r}_t^n = 0$ and $u_t = \rho_u u_{t-1} + e_t^u$. Solver for the equilibrium levels of $\hat{x}_t, \hat{\pi}_t, \hat{i}_t$ and $\hat{r}_t$ as a function of u_t.

Guess:

$$\hat{x}_t = \Psi_x u_t$$

$$\hat{\pi}_t = \Psi_\pi u_t$$

$$\Psi_x = \frac{\rho_u - \phi_\pi}{(1-\beta\rho_u)(1-\rho_u) - \kappa(\rho_u - \phi_\pi)}$$

$$\Psi_\pi = \frac{1-\rho_u}{(1-\beta\rho_u)(1-\rho_u) - \kappa(\rho_u - \phi_\pi)}$$

(c) Explain intuitively how a cost-push shock affects the output, inflation, the nominal interest rate, and the real interest rate. (max 4 sentences)

(d) Use your solution to express the loss function $L = \vartheta var(\hat{x}_t) + var(\hat{\pi}_t)$ as a function of the model parameters, where $var(\hat{x}_t)$ and $var(\hat{\pi}_t)$ are the variances of the output gap and inflation, respectively.

$$L = \theta \, var(\hat{x}_t) + var(\hat{\pi}_t)$$

$$= \theta \, var(\Psi_x u_t) + var(\Psi_\pi u_t)$$

$$= \theta \, \Psi_x^2 \, var(u_t) + \Psi_\pi^2 \, var(u_t)$$

$$\boxed{L = (\theta \Psi_x^2 + \Psi_\pi^2) \frac{\sigma_{\epsilon_u}^2}{(1-\rho^2)}}$$

$$V[u_t] = V[\rho u_{t-1}] + V[\epsilon_u]$$

$$V[u_t] = \rho^2 V[u_{t-1}] + \sigma_{\epsilon_u}^2$$

$$(1-\rho^2) V[u_t] = \sigma_{\epsilon_u}^2$$

$$V[u_t] = \frac{\sigma_{\epsilon_u}^2}{1-\rho^2}$$

(e) Show that the optimal interest rate rule satisfies $\phi_\pi = \rho_u + \frac{\kappa(1-\rho_u)}{\vartheta(1-\beta\rho_u)}$

minimize $L(\phi_\pi)$ wrt. to ϕ_π.

$$\min_{\phi_\pi} L(\phi_\pi) = \left(\theta\left[\frac{(\rho_u - \phi_\pi)}{(1-\beta\rho_u)(1-\rho_u) - \kappa(\rho_u - \phi_\pi)}\right]^2 + \left[\frac{1-\rho_u}{(1-\beta\rho_u)(1-\rho_u) - \kappa(\rho_u - \phi_\pi)}\right]^2 \right) A$$

$$A = \frac{\sigma_{\varepsilon u}^2}{1-\rho_u^2}$$

loss function in terms of params.

$$= \frac{\theta(\rho_u - \phi_\pi)^2 + (1-\rho_u)^2}{[(1-\beta\rho_u)(1-\rho_u) - \kappa(\rho_u - \phi_\pi)]^2} A$$

$$L = \frac{\theta(\rho_u - \phi_\pi)^2 + (1-\rho_u)^2}{[(1-\beta\rho_u)(1-\rho_u) - k(\rho_u - \phi_\pi)]^2} A$$

$$f(\phi_\pi) = \theta(\rho_u - \phi_\pi)^2 + (1-\rho_u)^2$$

$$g(\phi_\pi) = [(1-\beta\rho_u)(1-\rho_u) - k(\rho_u - \phi_\pi)]^{-2}$$

$$L = f(\phi_\pi)\, g(\phi_\pi) \cdot A$$

$$\frac{\partial L}{\partial \phi_\pi} = \left[f'(\phi_\pi)\, g(\phi_\pi) + f(\phi_\pi)\, g'(\phi_\pi)\right] A$$

$$f(\phi_\pi) = \theta(\rho_u - \phi_\pi)^2 + (1-\rho_u)^2$$

$$g(\phi_\pi) = \left[(1-\beta\rho_u)(1-\rho_u) - \kappa(\rho_u - \phi_\pi)\right]^{-2}$$

$$L = f(\phi_\pi)\, g(\phi_\pi) \cdot A$$

$$\frac{\partial L}{\partial \phi_\pi} = \left[f'(\phi_\pi)\, g(\phi_\pi) + f(\phi_\pi)\, g'(\phi_\pi)\right] A$$

$$f'(\phi_\pi) = -2\theta(\rho_u - \phi_\pi)$$

$$g'(\phi_\pi) = -2\kappa\left[(1-\beta\rho_u)(1-\rho_u) - \kappa(\rho_u - \phi_\pi)\right]^{-3}$$

$$\frac{\partial L}{\partial \phi_\pi} = \frac{-\cancel{2}\theta(\rho_u - \phi_\pi)}{\cancel{\left[(1-\beta\rho_u)(1-\rho_u) - \kappa(\rho_u - \phi_\pi)\right]^{2}}} - \frac{\cancel{2}\kappa\left[\theta(\rho_u - \phi_\pi)^2 + (1-\rho_u)^2\right]}{\left[(1-\beta\rho_u)(1-\rho_u) - \kappa(\rho_u - \phi_\pi)\right]^{\cancel{3}}} = 0$$

$$= -\theta(\rho_u - \phi_\pi)\left[(1-\beta\rho_u)(1-\rho_u) - \kappa(\rho_u - \phi_\pi)\right] - \kappa\left[\theta(\rho_u - \phi_\pi)^2 + (1-\rho_u)^2\right]$$

$$= 0$$

$$-\theta(\rho_u-\phi_\pi)\left[(1-\beta\rho_u)(1-\rho_u)-\kappa(\rho_u-\phi_\pi)\right]-\kappa\left[\theta(\rho_u-\phi_\pi)^2+(1-\rho_u)^2\right]=0$$

$$-\theta(\rho_u-\phi_\pi)(1-\beta\rho_u)(1-\rho_u)+\cancel{\kappa\theta(\rho_u-\phi_\pi)^2}-\cancel{\kappa\theta(\rho_u-\phi_\pi)^2}-\kappa(1-\rho_u)^2=0$$

$$\rho_u-\phi_\pi=-\frac{\kappa(1-\rho_u)^2}{\theta(1-\beta\rho_u)(1-\rho_u)}$$

$$\boxed{\phi_\pi^*=\frac{\kappa(1-\rho_u)^{\cancel{2}}}{\theta(1-\beta\rho_u)\cancel{(1-\rho_u)}}+\rho_u}$$

(f) Using the optimal ϕ_π, show that $\hat{x}_t = -\frac{\kappa}{\vartheta(1-\beta\rho_u)}\hat{\pi}_t$

$$\hat{x}_t = \Psi_x u_t \qquad\qquad \longrightarrow \qquad u_t = \frac{\hat{\pi}_t}{\Psi_\pi}$$

$$\hat{\pi}_t = \Psi_\pi u_t$$

$$\hat{x}_t = \frac{\Psi_x}{\Psi_\pi}\hat{\pi}_t$$

$$\boxed{\frac{\kappa(1-\rho_u)}{\theta(1-\beta\rho_u)\cancel{(1-\rho_u)}} + \rho_u}$$

$$\hat{x}_t = \frac{\rho_u - \phi_\pi^*}{1-\rho_u}\hat{\pi}_t$$

$$\hat{x}_t = \frac{\hat{\pi}_t}{\cancel{1-\rho_u}}\left(\cancel{\rho_u} - \cancel{\rho_u} - \frac{\kappa\cancel{(1-\rho_u)}}{\theta(1-\beta\rho_u)}\right)$$

(f) Using the optimal ϕ_π, show that $\hat{x}_t = -\frac{\kappa}{\vartheta(1-\beta\rho_u)}\hat{\pi}_t$

$$\hat{x}_t = \frac{\hat{\pi}_t}{\cancel{1-\rho_u}}\left(\cancel{\rho_u - \rho_u} - \frac{\kappa\cancel{(1-\rho_u)}}{\vartheta(1-\beta\rho_u)}\right)$$

$$\hat{x}_t = -\hat{\pi}_t \frac{\kappa}{\vartheta(1-\beta\rho_u)}$$

(g) The optimal monetary policy under discretion is $\hat{x}_t = -\frac{\kappa}{\vartheta}\hat{\pi}_t$.. Does the optimal ϕ_π deliver a better, a worse or the same loss? Explain intuitively. (NO derivatiosn needed)

$-\kappa/\theta$ discretion

$<$

$>$

$-\frac{\kappa}{\theta(1-\beta\rho_u)}$

A smaller coefficient, $|z|$, on $x_t = z\,\pi_t$ implies a better trade-off for the CB.

note: same trade-off if cost-push shock has zero persistence. ($\rho_u = 0$)

(g) The optimal monetary policy under discretion is $\hat{x}_t = \frac{\kappa}{\vartheta}\hat{\pi}_t$.. Does the optimal ϕ_π deliver a better, a worse or the same loss? Explain intuitively. (NO derivatiosn needed)

(g) The optimal monetary policy under discretion is $\hat{x}_t = \frac{\kappa}{\vartheta}\hat{\pi}_t$.. Does the optimal ϕ_π deliver a better, a worse or the same loss? Explain intuitively. (NO derivatiosn needed)