☑ Phillips curve

$$\hat{\pi} = \beta \hat{\pi}^e + \kappa \hat{y} + \varepsilon^{cp}$$

- $\hat{\pi} = \pi - \bar{\pi}$
- $\hat{y} = \frac{y - \bar{y}}{\bar{y}}$
- $\hat{\pi}^e = \pi^e - \bar{\pi}$

expectations are anchored

$\Leftrightarrow \quad \hat{\pi}^e = 0$

$\Leftrightarrow \quad \pi^e = \bar{\pi}$

- $\beta > 0$: discount factor

Lower β. more impatience

- $\kappa > 0$: $\Rightarrow$ nominal rigidities

☑ IS curve

$$\frac{c - \bar{y}}{\bar{y}} = -\gamma(\hat{i} - \hat{\pi}^e) + \varepsilon^d$$

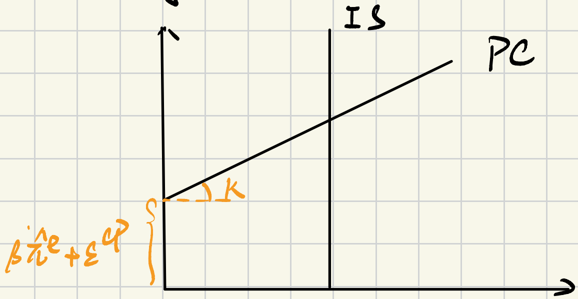
$$y = c + \underbrace{I + g + nx}_{=0} \Leftrightarrow y = c$$

$$\Downarrow$$

$$\hat{y} = -\gamma(\hat{i} - \hat{\pi}^e) + \varepsilon^d$$

☐ PC and IS

$$\begin{cases} \hat{\pi} = \beta \hat{\pi}^e + \kappa \hat{y} + \varepsilon^{cp} \\ \hat{y} = -\gamma(\hat{i} - \hat{\pi}^e) + \varepsilon^d. \end{cases}$$



⇒ Effect of shocks

VI Zero lower bound $\Leftrightarrow$ $\underset{0}{i} < 0$

VII Fisher equation

$$(1+i) = (1+\pi^e)(1+r)$$
$$\Updownarrow$$
$$i \approx \pi^e + r$$

RE

$$\pi^e_{t+1} = \pi_{t+1}$$

VIII Taloy Ruler

$$\hat{i} = \alpha_\pi \hat{\pi} + \alpha_y \hat{y} + \varepsilon^m$$

- $\alpha_\pi > 1$
- $\alpha_y > 0$

IX IS PC TR.

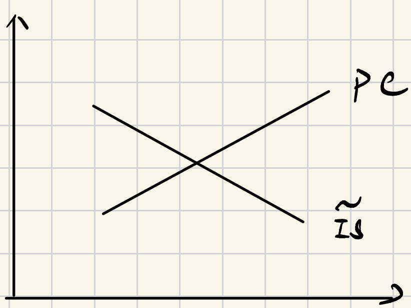
$$\hat{\pi} = \beta \hat{\pi}^e + \kappa \hat{y} + \varepsilon^{cp} \quad \text{PC}$$
$$\hat{y} = -\gamma(\hat{i} - \hat{\pi}^e) + \varepsilon^d \quad \text{IS}$$
$$\hat{i} = \alpha_\pi \hat{\pi} + \alpha_y \hat{y} + \varepsilon^m \quad \text{TR.}$$

$\Rightarrow \tilde{IS}$

eliminate $\hat{i}$ from IS by TR.

$$\hat{IS}: \quad \hat{\pi} = -\frac{1+\gamma\alpha_y}{\gamma\alpha_\pi}\hat{y} - \frac{1}{\alpha_\pi}\varepsilon^m + \frac{1}{\gamma\alpha_\pi}\varepsilon^d \quad ✓$$

$\hat{\pi}^e = 0$.



IS: $\hat{y} = -\gamma(\hat{i} - \hat{\pi}^e) + \varepsilon^d$

TR $\hat{i} = \alpha_\pi \hat{\pi} + \alpha_y \hat{y} + \varepsilon^m$

$$\Rightarrow \hat{y} = -\gamma(\alpha_\pi \hat{\pi} + \alpha_y \hat{y} + \varepsilon^m - \hat{\pi}^e) + \varepsilon^d.$$

$$= -\gamma\alpha_\pi \hat{\pi} - \gamma\alpha_y \hat{y} - \gamma\varepsilon^m + \gamma\hat{\pi}^e + \varepsilon^d$$

$$\Leftrightarrow \underline{\gamma\alpha_\pi} \hat{\pi} = -\hat{y} - \gamma\alpha_y \hat{y} - \gamma\varepsilon^m + \gamma\hat{\pi}^e + \varepsilon^d.$$

$$\hat{\pi} = -\frac{1+\gamma\alpha_y}{\gamma\alpha_\pi}\hat{y} - \frac{1}{\alpha_\pi}\varepsilon^m + \underbrace{\frac{1}{\alpha_\pi}\hat{\pi}^e}_{\Downarrow} + \frac{1}{\gamma\alpha_\pi}\varepsilon^d.$$

If anchored $\Leftrightarrow \hat{\pi}^e = 0$

[11] money velocity

$$\underline{M_t^d} = \frac{1}{V} P_t Y_t = M_t$$

[12] Grow rate in fixed velocity

$$\underbrace{\frac{P_t}{P_{t-1}}} = \underbrace{\frac{M_t}{M_{t-1}}} \cdot \underbrace{\frac{Y_{t-1}}{Y_t}}$$

$$1+\pi_t = \frac{1+\mu_t}{1+g_t}$$

$$\Rightarrow \quad 1+\mu_t = (1+\pi_t)(1+g_t)$$

$$\mu_t \approx \pi_t + g_t$$

$\boxed{\text{III}}$ Cagan model

$$M_t^d = L(\underset{\downarrow}{i_t}, \underset{\uparrow}{Y_t})$$

- decreasing in $\frac{i_t}{\sigma}$
- increasing in Y_t

with $$1 + i_t = (1 + r_t)(1 + \pi^e_{t+1})$$
$$= (1 + r_t)(1 + \pi_{t+1})$$

$\boxed{\text{III}}$

$$\frac{M_t}{P_t} = L(i_t, Y_t)$$

$$1 + i_t = (1 + r_t)(1 + \pi^e_{t+1})$$ $\underline{r}$ ex fixed.

$$M_{t+1} = (1 + \mu) M_t$$

Guess and verify

$\downarrow$

M_t / P_t

VII

$$\underbrace{G_t - \frac{T_t}{P_t}}_{DEF} = \frac{M_t - M_{t-1}}{P_t}$$ real term

$$DEF = \frac{M_t}{P_t} - \frac{M_{t-1}}{P_t} \qquad \frac{P_t}{P_{t-1}} = 1+\pi_t$$

$$DEF = \frac{M_t}{P_t} - \frac{1}{1+\pi_t}\,\frac{M_{t-1}}{P_t}$$

If $\frac{M_t}{P_t}$ is constant $\Rightarrow \mu_t = \pi_t$

$$DEF = \frac{M}{P} \cdot \frac{\pi_t}{1+\pi_t}$$

$$= L(\underset{0}{i}, y)\,\frac{\mu}{1+\mu}$$

$$= L(\underbrace{(1+r)(1+\mu)-1}_{i}, y)\,\frac{\mu}{1+\mu}$$

$\mu\uparrow \Rightarrow i\uparrow \Rightarrow L\downarrow$ $\qquad$ $\mu\uparrow \Rightarrow \frac{\mu}{1+\mu}\uparrow$