Session04

Sunday, November 19, 2023 9:25 AM

Money and Public Finance

Budget Accounting:

$$G_t + i_{t-1} B^T_{t-1} = T_t + (B^T_t - B^T_{t-1}) + RCB_t$$

$$(B^M_t - B^M_{t-1}) + RCB_t = i_{t-1} B^M_{t-1} + \underbrace{(H_t - H_{t-1})}_{\text{پول پرقدرت}}$$

$$G_t + i_{t-1} B^T_{t-1} + B^M_t - B^M_{t-1} + \cancel{RCB_t} = T_t + (B^T - B^T_{t-1})$$

$$+ \cancel{RCB_t} + i_{t-1} B^M_{t-1} + (H_t - H_{t-1})$$

$$G_t + i_{t-1}\underbrace{(B^T_{t-1} - B^M_{t-1})}_{B_{t-1}} = T_t + \left[\underbrace{(B^T_t - B^M_t)}_{B_t} - \underbrace{(B^T_{t-1} - B^M_{t-1})}_{B_{t-1}}\right]$$

$$+ (H_t - H_{t-1})$$

$$\frac{G_t}{P_t} + i_{t-1}\frac{B_{t-1}}{P_t} = \frac{T_t}{P_t} + \frac{(B_t - B_{t-1})}{P_t} + \frac{H_t - H_{t-1}}{P_t}$$

$$x_t = \frac{X_t}{P_t} \qquad \frac{B_{t-1}}{P_t} = \frac{B_{t-1}}{P_{t-1}} \cdot \frac{P_{t-1}}{P_t} = \frac{b_{t-1}}{1+\pi_t}$$

$$\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}} = \frac{P_t}{P_{t-1}} - 1 \Rightarrow \frac{P_{t-1}}{P_t} = \frac{1}{1+\pi_t}$$

$$g_t + i_{t-1}\frac{b_{t-1}}{1+\pi_t} = t_t + b_t - \frac{b_{t-1}}{1+\pi_t} + h_t - \frac{h_{t-1}}{1+\pi_t}$$

$$\bar{r}_{t-1} = \frac{1+i_{t-1}}{1+\pi_t} - 1$$

$$g_t + \bar{r}_{t-1} b_{t-1} = t_t + b_t - b_{t-1} + h_t - \frac{h_{t-1}}{1+\pi_t}$$

$$1 + i_{t-1} = (1 + r_{t-1})(1 + \pi^e_t)$$

$$r_{t-1} - \bar{r}_{t-1} = \frac{(\pi_t - \pi^e_t)(1 + r_{t-1})}{1 + \pi_t}$$

$$g_t + r_{t-1} b_{t-1} - (r_{t-1} - \bar{r}_{t-1}) b_{t-1} = t_t + b_t - b_{t-1} + h_t - \frac{h_{t-1}}{1+\pi_t}$$

$$g_t + r_{t-1} b_{t-1} = t_t + (b_t - b_{t-1}) + \frac{(\pi_t - \pi^e_t)(1 + r_{t-1})}{1+\pi_t} b_{t-1}$$

$$+ \underbrace{\left[h_t - \frac{1}{1+\pi_t} h_{t-1}\right]}$$

حق الضرب پول

$$s_t = \frac{H_t - H_{t-1}}{P_t} = h_t - h_{t-1} + \left(\frac{\pi_t}{1+\pi_t}\right) h_{t-1}$$

θ

$$\frac{\pi}{1+\pi} h = \frac{\theta}{1+\theta} h$$

سوال:

مهمترین ابزار سیاست‌گذاری پولی چیست؟

$$d_t = b_t + h_t$$

$$g_t + r_{t-1} d_{t-1} = t_t + (d_t - d_{t-1}) + \frac{(\pi_t - \pi^e_t)}{1+\pi_t}(1 + r_{t-1}) d_{t-1}$$

$$+ \underbrace{\frac{i_{t-1}}{1+\pi_t} h_{t-1}}$$

$$\bar{s} = \frac{i}{1+\pi} h$$

$$\{g_{t+i}, b_{t+i}\}_{t=0}^{\infty} = 0$$

Intertemporal Budget Balance

$\{g_{t+i}, b_{t+i}\}_{t=0}^{\infty} = 0$

Intertemporal Budget Balance

$$g_t + r_{t-1}b_{t-1} = t_t + (b_t - b_{t-1}) + s_t$$

$$y_t = \alpha + \beta y_{t-1} + \varepsilon_t$$

$$x_t = \theta + \gamma x_{t-1} + u_t$$

$$y_t = \alpha \sum_{i=0}^{n} \beta^i + \beta^{n+1} y_{-1} + \sum_{i=0}^{n} \beta^i \varepsilon_{t-i}$$

$$(1+r)b_{t-1} + \sum_{i=0}^{\infty} \frac{g_{t+i}}{(1+r)^i} = \sum_{i=0}^{\infty} \frac{t_{t+i}}{(1+r)^i} + \sum_{t=0}^{\infty} \frac{s_{t+i}}{(1+r)^i} + \cancel{\lim_{i \to \infty} \frac{b_{t+i}}{(1+r)^i}}$$

صفر

$$(1+r)b_{t-1} = -\sum_{i=0}^{\infty} \frac{\Delta_{t+i}}{(1+r)^i}$$

$\Delta = g - t - s$ کسری بودجه

Money and Fiscal Policy Framework:

$$W = B + M$$

Deficits and Inflation:

$$R = 1 + r$$

$$b_{t-1} = -R^{-1} \sum_{i=0}^{\infty} R^{-i} (g_{t+i} - t_{t+i} - s_{t+i})$$

$$s^f = t - g$$

$$b_{t-1} = R^{-1} \sum_{i=0}^{\infty} R^{-i} s^f_{t+i} + R^{-1} \sum_{i=0}^{\infty} R^{-i} s_{t+i}$$

Unpleasant monetarist arithmetic

Ricardian and Non-Ricardian Fiscal Policies:

$\frac{M}{P}\uparrow$ Metzler (1951)

$g = 0$

$$(1+r_{t-1})b_{t-1} = t_t + b_t + s_t$$

$$c_t + M_t + b_t = y_t + (1+r_{t-1})b_{t-1} + \frac{M_{t-1}}{1+\pi_t} - t_t \; *$$

$$1 + r_{t-1} = \frac{1+i_{t-1}}{1+\pi_t}$$

Aiyagari and Gertler (1985)

مالیات‌ها نسبت ψ از بدهی‌های با هزینه بهره را تشکیل می‌دهد

$0 \le \psi \le 1$ Ricardian $\Rightarrow \psi = 1$

if $\psi < 1$ non-Ricardian

$$T_t = \psi (1+r_{t-1}) b_{t-1} \Rightarrow T_{t+1} = \psi (1+r_t) b_t$$

ارزش تنزیل یافته مالیات‌ها

$$T_t = t_t + E(\underline{T_{t+1}}) = t_t + E_t[\underline{\psi(1+r_t)b_t}]$$

ارزش تنزیل یافته مالیات‌ها

$$T_t = t_t + E\left(\frac{T_{t+1}}{1+r_t}\right) = t_t + E_t\left[\frac{\psi(1+r_t)b_t}{1+r_t}\right]$$

$$T_t = t_t + \psi b_t$$

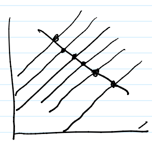
$$T_t = \psi(1+r_{t-1})\, b_{t-1} = t_t + \psi b_t$$

$$\star \rightarrow t_t = \psi(R_{t-1} b_{t-1} - b_t) \Rightarrow R = 1+r$$

$$c_t + m_t + (1-\psi) b_t = y_t + (1-\psi) R_{t-1} b_{t-1} + \frac{m_{t-1}}{1+\pi_t}$$

if $\psi < 1$ $\qquad W = m + (1-\psi) b$

$$c_t + w_t + \frac{i_{t-1} m_{t-1}}{1+\pi_t} = y + R_{t-1} w_{t-1}$$



$$U = \ln c_t + \delta \ln m_t$$

$$\frac{U'_m}{U'_c} = \frac{i_t}{1+i_t}$$

$$\frac{\frac{\delta}{m_t}}{\frac{1}{c_t}} = \frac{i_t}{1+i_t}$$

$$m_t = \frac{\delta c_t (1+i_t)}{i_t}$$

تقاضای پول

$$c_{t+1} = \beta(1+r_t) c_t$$

$$y + R_{t-1} w_{t-1} = c_t + w_t + \left(\frac{\cancel{i_{t-1}}}{\cancel{1+\pi_t}}\right)\delta\left(\frac{\cancel{1+i_{t-1}}}{\cancel{i_{t-1}}}\right)\frac{c_t}{\cancel{\beta(1+r_{t-1})}}$$

$$= \left(1 + \frac{\delta}{\beta}\right) c_t + w_t$$

$g = 0 \qquad I = 0 \qquad y = c$

$$R_{t-1} W_{t-1} = \frac{\delta}{\beta} y + w_t$$

$$W_{t-1} = W_t = W^{ss} = \frac{\delta y}{\beta(R-1)}$$

$$W = \frac{M + (1-\psi) B}{P} = \frac{\delta y}{\beta(R-1)}$$

$$P^{ss} = \left(\frac{\beta r^{ss}}{\delta y}\right)\left[M + (1-\psi) B\right]$$

Fiscal Theory of the Price Level

FTPL

$$\lambda = \frac{M}{M+B}$$

$$P^{ss} = \left(\frac{\beta r^{ss}}{\delta y}\right)\left[1 - \psi(1-\lambda)\right](M+B)$$

$$p^{ss} = \left(\frac{\beta\, r^{ss}}{\delta\, y}\right)\left[1 - \varphi(1-\lambda)\right](M + B)$$

Sargent and walace

perfect foresight

$$\frac{U'_m(c_t, m_t)}{U'_c(c_t, m_t)} = \frac{i_t}{1+i_t}$$

$$U(c_t, m_t) = \frac{\left[a c_t^{1-b} + (1-a) m_t^{1-b}\right]^{\frac{1-\phi}{1-b}}}{1-\phi}$$

$$m_t = \frac{M_t}{P_t} = \left[\frac{i_t}{1+i_t}\left(\frac{a}{1-a}\right)\right]^{-\frac{1}{b}} c_t$$

$$R_m = 1 + i \Rightarrow \frac{i_t}{1+i_t} = \frac{R_{mt} - 1}{R_{mt}}$$

$$\boxed{\frac{M_t}{P_t} = f(R_{m,t})}$$

$$f(R_{m,t}) = \left[\frac{R_{m,t} - 1}{R_{mt}}\left(\frac{a}{1-a}\right)\right]^{-\frac{1}{b}} c_t$$

$$\frac{M_0}{P_0} = f(R_m)$$

$$P_0 = \frac{M_0}{f(R_m)}$$

$$g_t + r b_{t-1} = t_t + (b_t - b_{t-1}) + m_t - \left(\frac{1}{1+\Pi_t}\right) m_{t-1}$$

g, b, t ثابت

$$g + rb = t + m - \frac{1}{1+\Pi} m$$

$$1 + r = \frac{1}{\beta} \Rightarrow r = \frac{1}{\beta} - 1$$

$$g + \left(\frac{1}{\beta} - 1\right) b = t + \left(\frac{\Pi}{1+\Pi}\right) m$$

$$1 + i = \frac{1+r}{1+\Pi} = R_m \Rightarrow R_m = \frac{1+\Pi}{\beta}$$

$$\Pi = R_m \beta - 1$$

$$g + \left(\frac{1}{\beta} - 1\right) b = t + \left(\frac{\beta R_m - 1}{\beta R_m}\right) f(R_m)$$

Fiscal Dominance

Active Fiscal Policy

Passive Monetary Policy

Equilibrium Seigniorage:

Δf $\quad \pi \uparrow \quad \dfrac{M \uparrow}{P \uparrow}$

Cagan (1956)

$$\frac{M_t - M_{t-1}}{P_t}$$

$$\sum_{t=0}^{\infty} \beta^t u(c_t, m_t)$$

$$c_t + b_t + m_t = y_t - \tau_t + (1+r) b_{t-1} + \frac{m_{t-1}}{\Pi_t}$$

$$\Pi_t = 1 + \pi_t = \frac{P_t}{P_{t-1}}$$ تورم ناخالص

$$w_t = b_t + m_t, \quad R_t = 1 + r_t$$

$$c_t + w_t = y_t - \tau_t + R_{t-1} w_{t-1} - \left(\frac{R_{t-1}\Pi_t - 1}{\Pi_t} \right) m_{t-1}$$

$$= y_t - \tau_t + R_{t-1} w_{t-1} - \frac{i_{t-1}}{\Pi_t} m_{t-1}$$

$$\frac{u'_m(c_t, m_t)}{u'_c(c_t, m_t)} = \frac{i_t}{1+i_t}$$

$$u'_c(c_t, m_t) = \frac{\beta\, i_t}{\Pi_{t+1}} u'_c(c_{t+1}, m_{t+1})$$

$$u'_m(c_t, m_t) = \frac{i_t}{R_t \Pi_{t+1}} u'_c(c_t, m_t) = \frac{i_t}{1+i_t} u'_c(c_t, m_t)$$

$$R_t = (1+r_t) = \frac{1+i_t}{1+\pi_{t+1}} = \frac{1+i_t}{\Pi_{t+1}}$$

$$u(c_t, m_t) = \ln c_t + m_t(B - D\ln m_t)$$

که پارامتر هستند هیچ ربطی به اوراق، سپرده. دیفرانسیل و
هرچیز دیگه ندارند

$$u'_c = \frac{1}{c_t}$$

$$u'_m = B - D\ln m_t - D\frac{m_t}{m_t} = B - D - D\ln m_t$$

$$\frac{u'_m}{u'_c} = \frac{B - D - D\ln m_t}{1/c_t} = \frac{i_t}{1+i_t}$$

$$B - D - D\ln m_t = \overbrace{\frac{i_t}{1+i_t}}^{\omega_t}\frac{1}{c_t}$$

$$D\ln m_t = B - D - \frac{\omega_t}{c_t}$$

$$\ln m_t = \left(\frac{B}{D} - 1\right) - \frac{\omega_t}{Dc_t}$$

$$m_t = e^{\frac{B}{D}-1} \cdot e^{-\frac{\omega_t}{Dc_t}}$$

$$m_t = A\, e^{-\frac{\omega_t}{Dc_t}}$$

$$m = K e^{-\alpha\pi^e}$$

$$\frac{i\,m}{1+\pi} = \frac{i}{\frac{1+i}{1+r}} \cdot m = \frac{(1+r)\,i\,m}{1+i} \qquad \omega_t = \frac{i_t}{1+i}$$

$$\bar{\zeta} = (1+r)\frac{i}{1+i}m = (1+r)\frac{i}{1+i}A\exp\left(-\frac{i}{Dc(1+i)}\right)$$

$$\frac{\partial\bar{\zeta}}{\partial\pi} = \frac{\partial\bar{\zeta}}{\partial\omega} \cdot \frac{\partial\omega}{\partial i} \cdot \frac{\partial i}{\partial\pi}$$

$$\omega = \frac{i}{\;} \qquad \frac{\partial\omega}{\;} = \frac{1}{\;}$$

$$\omega = \frac{i}{1+i} \qquad \frac{\partial \omega}{\partial i} = \frac{1}{(1+i)^2}$$

$$(1+r) = \frac{1+i}{1+\pi} \Rightarrow i = (1+r)(1+\pi) - 1$$

$$\frac{\partial i}{\partial \pi} = (1+r)$$

$$\frac{\partial \bar{S}}{\partial \pi} = \underline{\frac{\partial \bar{S}}{\partial \omega}} \cdot \overset{+}{\frac{1}{(1+i)^2}} \cdot \overset{+}{(1+r)}$$

$$S = (1+r)A\omega \exp\left(-\frac{\omega}{Dc}\right)$$

$$\frac{\partial \bar{S}}{\partial \omega} = (1+r)A \exp\left(-\frac{\omega}{Dc}\right) - (1+r)\frac{A\omega}{Dc} \exp\left(-\frac{\omega}{Dc}\right)$$

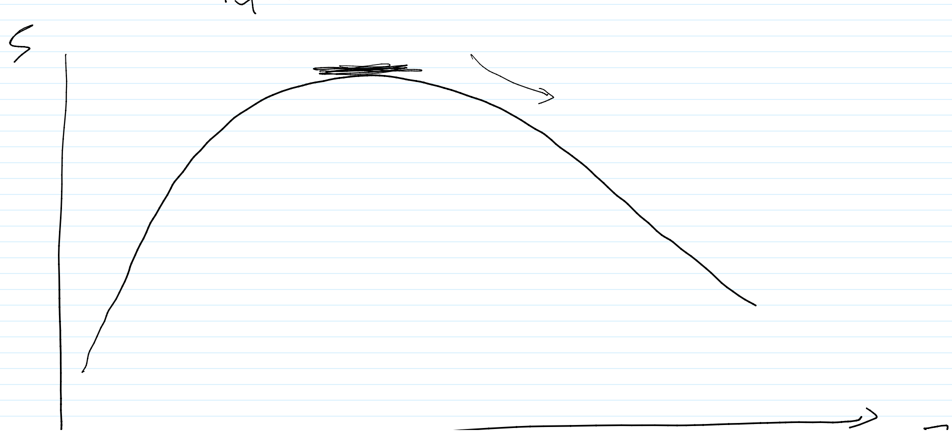
$$= (1+r)A\left[1 - \frac{\omega}{Dc}\right] \exp\left(-\frac{\omega}{Dc}\right) = \frac{\bar{S}}{\omega}\left[1 - \frac{\omega}{Dc}\right]$$

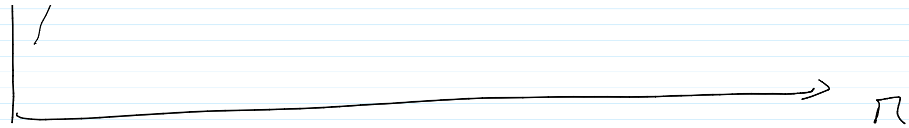
$$\bar{S} = (1+r)A\omega \exp\left(-\frac{\omega}{Dc}\right)$$

$$\frac{\partial \bar{S}}{\partial \pi} = 0 \Rightarrow 1 - \frac{\omega}{Dc} = 0 \qquad \omega = Dc$$

$$\frac{i}{1+i} = Dc \qquad \pi^{max} = \left(\frac{1}{1+r}\right)\frac{1}{(1-Dc)} - 1$$

$$\frac{1+i}{1+\pi} = 1+r$$





Cagan's Model:

$$s^f = \frac{\dot{H}}{H}\frac{H}{PY} = \theta h$$

$$h = \exp(-\alpha \pi^e)$$

$$s^f = \theta e^{-\alpha \pi^e}$$

$\pi = \theta - \mu \longrightarrow$ رشد اقتصادی

$$\pi^e = \pi$$

$$\pi_t = \pi_{t-1} = E_t \pi_{t+1} = \bar{\pi}$$

$$s^f = \theta e^{-\alpha(\theta - \mu)}$$

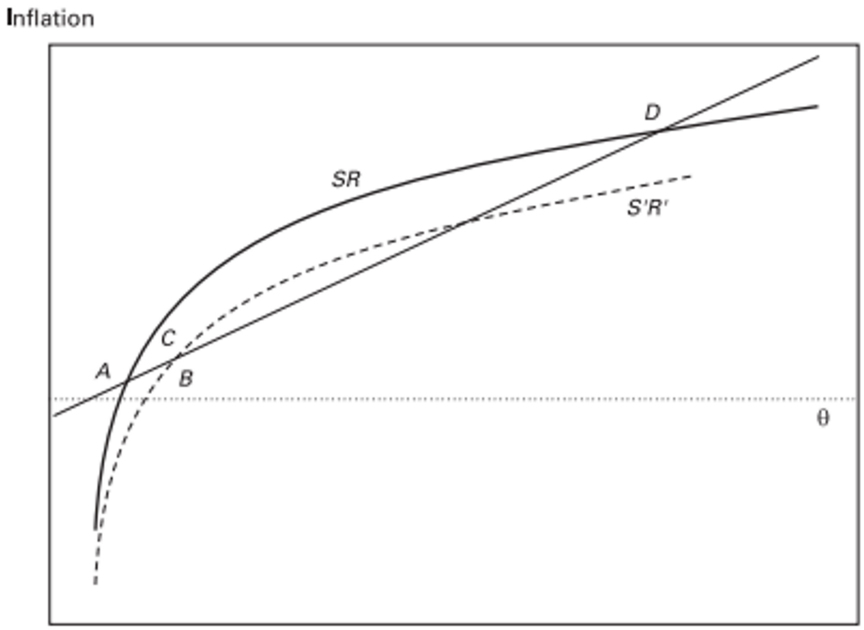
$$s^f = 0 \Rightarrow \theta = 0$$

$$\frac{\partial s^f}{\partial \theta} = e^{-\alpha(\theta-\mu)} - \alpha\theta e^{-\alpha(\theta-\mu)} = 0$$

$$\theta = \frac{1}{\alpha}$$

$$\pi = \theta - \mu = \frac{1}{\alpha} - \mu$$

$$s^* = \frac{1}{\alpha} e^{-\alpha(\frac{1}{\alpha} - \mu)} = \frac{1}{\alpha} e^{\alpha\mu - 1}$$



$$\frac{\partial \pi^e}{\partial t} = \dot{\pi}^e = \eta(\pi - \pi^e)$$

$$h = e^{-\alpha \pi^e}$$

$$\frac{\dot{h}}{h} = \theta - \mu - \pi = -\alpha \dot{\pi}^e = -\alpha \eta (\pi - \pi^e)$$

$$\pi = \frac{\theta - \mu - \alpha \eta \pi^e}{1 - \alpha \eta}$$

$$\dot{\pi}^e = \frac{\eta(\theta - \mu - \pi^e)}{1 - \alpha \eta}$$

$$\alpha \eta < 1 \Rightarrow \eta < \frac{1}{\alpha}$$

Rational Hyperinflation

$$m_t - P_t = -\alpha (E_t P_{t+1} - P_t)$$

$$(1+\alpha) P_t = m_t + \alpha E_t P_{t+1}$$

$$\boxed{P_t = \frac{1}{1+\alpha} m_t + \frac{\alpha}{1+\alpha} E_t P_{t+1}}$$

تقاضای پول

$$\boxed{m_t = \theta_0 + (1-\gamma)\theta_1 t + \gamma m_{t-1}}$$ عرضه پول

$$m_{t-1} = \theta_0 + (1-\gamma)\theta_1(t-1) + \gamma m_{t-2}$$

نرخ رشد پول $$\boxed{m_t - m_{t-1} = (1-\gamma)\theta_1 + \gamma(m_{t-1} - m_{t-2})}$$

$$mg_t = (1-\gamma)\theta_1 + \gamma\, mg_{t-1}$$

$$\overline{mg} = (1-\gamma)\theta_1 + \gamma\,\overline{mg}$$

$$\boxed{\overline{mg} = \theta_1}$$

$$P_t = \frac{1}{1+\alpha} m_t + \frac{\alpha}{1+\alpha} E_t P_{t+1}$$

$$E_t P_{t+1} = \frac{1}{1+\alpha} E_t m_{t+1} + \frac{\alpha}{1+\alpha} E_t E_{t+1} P_{t+2}$$

$$E_t P_{t+2}$$

$$m_t = \theta_0 + (1-\gamma)\theta_1 t + \gamma m_{t-1}$$

$$E_t m_{t+1} = \theta_0 + (1-\gamma)\theta_1 t + \gamma m_t$$

$$P_t = \frac{\alpha[\theta_0 + (1-\gamma)\theta_1(1+\alpha)]}{1+\alpha(1-\gamma)} + \frac{\alpha(1-\gamma)\theta_1}{1+\alpha(1-\gamma)} t + \frac{1}{1+\alpha(1-\gamma)}$$

$$P_t = A_0 + A_1 t + A_2 m_t$$

$$E_t P_{t+1} = A_0 + A_1(t+1) + A_2 E_t m_{t+1} = A_0 + A_1(t+1) + A_2(\theta_0 + (1-\gamma$$

نرخ تورم $\longrightarrow \theta_1$

$$P_t = A_0 + A_1 t + A_2 m_t + B_t = \frac{m_t}{1+\alpha} + \frac{\alpha[A_0 + A_1(t+1) + A_2 E_t m}{1+\alpha}$$

$$A_0 = \frac{\alpha[\theta_0 + (1-\gamma)\theta_1(1+\alpha)]}{1+\alpha(1-\gamma)}, \quad A_1 = \frac{\alpha(1-\gamma)\theta_1}{1+\alpha(1-\gamma)}, \quad A_2 = \frac{1}{1+\alpha}$$

m_t

$\theta_1(t+1) + \gamma m_t)$

$t+1 + \mathcal{E}_t B_{t+1}]$

$(1-\gamma)$

$$B_t = \frac{\alpha}{1+\alpha} E_t B_{t+1}$$

$$B_{t+1} = k B_t \quad , \quad k = \frac{1+\alpha}{\alpha} > 1$$

$$k - 1 = \frac{1}{\alpha}$$

The Fiscal Theory of the Price Level:

$$D_t + P_t y_t - T_t \geq P_t c_t + M_t^d + B_t^d = P_t c_t + \left(\frac{i_t}{1+i_t}\right) M_t^d + \left(\frac{1}{1+i_t}\right) D_{t+1}^d$$

ثروت اولیه

$$D_{t+1}^d = (1+i_t) B_t^d + M_t^d$$

$$d_t + y_t - \tau_t \geq c_t + m_t^d + b_t^d = c_t + \left(\frac{i_t}{1+i_t}\right) m_t^d + \left(\frac{1}{1+r_t}\right) d_{t+1}^d$$

$$1 + r_t = (1+i_t)(1+\pi_{t+1})$$

$$\lambda_{t,t+i} = \prod_{j=1}^{i} \left(\frac{1}{1+r_{t+j}}\right) \quad , \quad \lambda_{t,t} = 1$$

$$d_t + \sum_{i=0}^{\infty} \lambda_{t,t+i}(y_{t+i} - \tau_{t+i}) = \sum_{i=0}^{\infty} \lambda_{t,t+i}\left[c_{t+i} + \left(\frac{i_{t+i}}{1+i_{t+i}}\right) m$$

بودجه دولت

$$P_t g_t + (1+i_{t-1}) B_{t-1} = T_t + M_t - M_{t-1} + B_t$$

$$g_t + d_t = \tau_t + \left(\frac{i_t}{1+i_t}\right) m_t + \left(\frac{1}{1+r_t}\right) d_{t+1}$$

$$d_t + \sum_{i=0}^{\infty} \lambda_{t,t+i}\left[g_{t+i} - \tau_{t+i} - s_{t+i}\right] = \boxed{\lim_{T\to\infty} \lambda_{t,t+T}\, d_T} =$$

$$ {}^{d}_{n_{t+i}} \Big] $$

0

$$d_t + \sum_{i=0} \lambda_{t,t+i}\Big[\underbrace{g_{t+i} - \tau_{t+i} - s_{t+i}}_{\text{کسری بودجه}}\Big] = \boxed{\lim_{T\to\infty} \lambda_{t,t+T}}$$

$$s_t = \frac{i_t \, m_t}{1+i_t}$$

$$\lim_{T\to\infty} \lambda_{t,t+T} \, d_T = 0$$ برای کلیه سطوح قیمت P_t

مسیر ابزارهای سیاستی

$$(g_{t+i}, \tau_{t+i}, s_{t+i}, d_{t+i})_{i\geq 0}$$

if $\lim_{T\to\infty} \lambda_{t,t+T} \, d_T = 0$ for all paths of P_{t+i}, $i \geq$

$$= \lim_{T\to\infty} \lambda_{t,t+T} \, d_T \neq 0 \quad \sim \quad \sim \quad \sim$$

$$y_t = c_t + g_t \Rightarrow c_t = y_t - g_t$$

$$m^d_t = m_t$$

$$d_t + \sum_{i=0}^{\infty} \lambda_{t,t+i}\left[g_{t+i} - \tau_{t+i} - \left(\frac{i_{t+i}}{1+i_{t+i}}\right) m \ldots\right.$$

Ricardian

non-Ricardian

$\Rightarrow$ Ricardian

$\Rightarrow$ Non-Ricardian

$$t+i \Big] = 0$$

$$d_t = \frac{D_t}{P_t} = \sum_{i=0}^{\infty} \lambda_{t,t+i}\left[\tau_{t+i} + \bar{s}_{t+i} - g_{t+i}\right]$$

$$\frac{M_t}{P_t} = f(1+i)$$

$$i_{t+i} = \bar{i}$$

$$\bar{s}_t = \left(\frac{i_t}{1+i_t}\right) M^d \Rightarrow \bar{s} = \frac{\bar{i}}{1+\bar{i}} f(1+\bar{i})$$

$$P_t^* = \frac{D_t}{\sum_{i=0}^{\infty} \lambda_{t,t+i}\left[\tau_{t+i} + \bar{s}_{t+i} - g_{t+i}\right]}$$

$$M_t = P^* f(1+\bar{i})$$

$$\frac{}{\sum_{i=0}^{\infty} \lambda_{t,t+i} s_{t+i}}$$

Optimal Taxation and Seigniorage:

A partial Equilibrium Model:

$t + i \Big\}$

$$\bar{g} \qquad \bar{R}$$

$$b_t = R b_{t-1} + g - \tau_t - s_t$$

$$s_t = \frac{M_t - M_{t-1}}{P_t} = m_t - \frac{m_{t-1}}{1+\pi_t}$$

$$E_t \sum_{i=0}^{\infty} R^{-i} (\tau_{t+i} + s_{t+i}) = R b_{t-1} + \left(\frac{R}{1+R}\right) g$$

$$E_t \lim_{i \to \infty} R^{-i} b_{t+i} = 0$$