

1. Household

$$\max E_t \{ \beta^t \mu_t^\beta [ \frac{(C_t^h)^{1-\sigma}}{1-\sigma} - \chi \frac{L_t^{1+\gamma}}{1+\gamma} ] \}$$

$$\text{s. t. } C_t^h + D_t = W_t L_t + R_{t-1} D_{t-1} / \pi_t + \Pi_t$$

$$W_t = (C_t^h)^\sigma L_t^\gamma \quad (1)$$

$$\frac{\mu_t^\beta}{R_t} = E_t \left[ \beta \mu_{t+1}^\beta \left( \frac{C_{t+1}^h}{C_t^h} \right)^{-\sigma} \frac{1}{\pi_{t+1}} \right] \quad (2)$$

2. Entrepreneur

$$\max E_t \{ \beta^t \frac{(C_t^e)^{1-\sigma}}{1-\sigma} \}$$

$$\text{s. t. } C_t^e + I_t + W_t L_t = Y_t / X_t \quad K_t = (1-\delta)K_{t-1} + I_t$$

$$\text{Lagrange equation: } L = \beta^t \left( \frac{(C_t^e)^{1-\sigma}}{1-\sigma} - \lambda_t (C_t^e + K_t - (1-\delta)K_{t-1} + W_t L_t - Y_t / X_t) \right)$$

The liquidity constraint equation of entrepreneurs:

$$C_t^e + I_t + W_t L_t = Y_t / X_t \quad (3)$$

$$\text{Capital accumulation equation } K_t = (1-\delta)K_{t-1} + I_t \quad (4)$$

$$\text{production function } Y_t = A_t K_{t-1}^\alpha L_t^{1-\alpha} \quad (5)$$

$$\text{Partial derivation to } K_t \quad 1 = E_t \left[ \beta \left( \frac{C_{t+1}^e}{C_t^e} \right)^{-\sigma} \left( \frac{\alpha Y_{t+1}}{K_t X_{t+1}} + 1 - \delta \right) \right] \quad (6)$$

$$\text{Partial derivation to } L_t \quad W_t = (1-\alpha) A_t K_{t-1}^\alpha L_t^{-\alpha} / X_t \quad (7)$$

$$\text{Definition in formula (6) } R_{t+1}^k = \frac{\alpha Y_{t+1}}{K_t X_{t+1}} \text{ so } R_t^k = \alpha A_t K_{t-1}^{\alpha-1} L_t^{1-\alpha} / X_t \quad (8)$$

3. Retailers (Phillips curve)

$$\hat{\pi}_t = \beta E_t \hat{\pi}_{t+1} - \frac{(1-\theta)(1-\beta\theta)}{\theta} \hat{x}_t + \mu_t^\pi \quad (9)$$

4. equation

$$Y_t = C_t^h + C_t^e + I_t \quad (10)$$

5. monetary policy

$$\ln\left(\frac{R_t}{R}\right) = \kappa_r \ln\left(\frac{R_t}{R}\right) + (1-\kappa_r) [\kappa_y \ln\left(\frac{Y_t}{Y}\right) + \kappa_\pi \ln\left(\frac{\pi_t}{\pi}\right)] + \mu_t^r \quad (11)$$

6. shocks

$$\mu_t^a = \rho_a \mu_{t-1}^a + \varepsilon_t^a \quad \mu_t^r = \rho_r \mu_{t-1}^r + \varepsilon_t^r$$