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1 CONSUMER

1.1 Optimisation problem

$$\max_{K_t, C_t, H_t, I_t} U_t = \beta \mathrm{E}_t \left[U_{t+1} \right] + (1-\eta)^{-1} \left({C_t}^{\mu} (1-H_t)^{1-\mu} \right)^{1-\eta} \tag{1.1}$$

s.t. :

$$C_t + I_t + T_t = \pi_t + TR_t + K_{t-1} r_t + H_t W_t - \psi K_{t-1} \left(-\delta + {K_{t-1}}^{-1} I_t \right)^2 \quad (\lambda_t^{\mathrm{c}}) \tag{1.2}$$

$$K_t = I_t + K_{t-1} (1-\delta) \quad \left(\lambda_t^{\mathrm{CONSUMER}^2} \right) \tag{1.3}$$

1.2 First order conditions

$$-\lambda_t^{\mathrm{CONSUMER}^2} + \beta \left((1-\delta) \mathrm{E}_t \left[\lambda_{t+1}^{\mathrm{CONSUMER}^2} \right] + \mathrm{E}_t \left[\lambda_{t+1}^{\mathrm{c}} \left(r_{t+1} - \psi \left(-\delta + {K_t}^{-1} I_{t+1} \right)^2 + 2\psi {K_t}^{-1} I_{t+1} \left(-\delta + {K_t}^{-1} I_{t+1} \right) \right) \right] \right) = 0 \quad (K_t) \tag{1.4}$$

$$-\lambda_t^{\mathrm{c}} + \mu {C_t}^{-1+\mu} (1-H_t)^{1-\mu} \left({C_t}^{\mu} (1-H_t)^{1-\mu} \right)^{-\eta} = 0 \quad (C_t) \tag{1.5}$$

$$\lambda_t^{\mathrm{c}} W_t + (-1+\mu) {C_t}^{\mu} (1-H_t)^{-\mu} \left({C_t}^{\mu} (1-H_t)^{1-\mu} \right)^{-\eta} = 0 \quad (H_t) \tag{1.6}$$

$$\lambda_t^{\mathrm{CONSUMER}^2} + \lambda_t^{\mathrm{c}} \left(-1 - 2\psi \left(-\delta + {K_{t-1}}^{-1} I_t \right) \right) = 0 \quad (I_t) \tag{1.7}$$

2 FIRM

2.1 Optimisation problem

$$\max_{K_t^{\mathrm{d}}, H_t^{\mathrm{d}}, Y_t, \pi_t} \Pi_t = \pi_t \tag{2.1}$$

s.t. :

$$Y_t = Z_t {H_t^{\mathrm{d}}}^{1-\alpha} {K_t^{\mathrm{d}}}^{\alpha} \quad \left(\lambda_t^{\mathrm{FIRM}^1} \right) \tag{2.2}$$

$$\pi_t = Y_t - H_t^{\mathrm{d}} W_t - r_t K_t^{\mathrm{d}} \quad \left(\lambda_t^{\mathrm{FIRM}^2} \right) \tag{2.3}$$

2.2 First order conditions

$$-\lambda_t^{\mathrm{FIRM}^2} r_t + \alpha \lambda_t^{\mathrm{FIRM}^1} Z_t {H_t^{\mathrm{d}}}^{1-\alpha} {K_t^{\mathrm{d}}}^{-1+\alpha} = 0 \quad \left(K_t^{\mathrm{d}}\right) \tag{2.4}$$

$$-\lambda_t^{\mathrm{FIRM}^2} W_t + \lambda_t^{\mathrm{FIRM}^1} Z_t \left(1-\alpha\right) {H_t^{\mathrm{d}}}^{-\alpha} {K_t^{\mathrm{d}}}^{\alpha} = 0 \quad \left(H_t^{\mathrm{d}}\right) \tag{2.5}$$

$$-\lambda_t^{\mathrm{FIRM}^1} + \lambda_t^{\mathrm{FIRM}^2} = 0 \quad \left(Y_t\right) \tag{2.6}$$

$$1 - \lambda_t^{\mathrm{FIRM}^2} = 0 \quad \left(\pi_t\right) \tag{2.7}$$

2.3 First order conditions after reduction

$$-r_t + \alpha Z_t {H_t^{\mathrm{d}}}^{1-\alpha} {K_t^{\mathrm{d}}}^{-1+\alpha} = 0 \quad \left(K_t^{\mathrm{d}}\right) \tag{2.8}$$

$$-W_t + Z_t \left(1-\alpha\right) {H_t^{\mathrm{d}}}^{-\alpha} {K_t^{\mathrm{d}}}^{\alpha} = 0 \quad \left(H_t^{\mathrm{d}}\right) \tag{2.9}$$

3 CONSUMER*

3.1 Optimisation problem

$$\max_{K_t^*, C_t^*, H_t^*, I_t^*} U_t^* = \beta \mathrm{E}_t \left[U_{t+1}^*\right] + \left(1-\eta\right)^{-1} \left(C_t^{*\mu} (1-H_t^*)^{1-\mu}\right)^{1-\eta} \tag{3.1}$$

s.t. :

$$C_t^* + I_t^* + T_t^* = \pi_t^* - TR_t + K_{t-1}^* r_t^* + H_t^* W_t^* - \psi K_{t-1}^* \left(-\delta + {K_{t-1}^*}^{-1} I_t^*\right)^2 \quad \left(\lambda_t^{\mathrm{c}^*}\right) \tag{3.2}$$

$$K_t^* = I_t^* + K_{t-1}^* \left(1-\delta\right) \quad \left(\lambda_t^{\mathrm{CONSUMER}^{*^2}}\right) \tag{3.3}$$

3.2 First order conditions

$$-\lambda_t^{\mathrm{CONSUMER}^{*^2}} + \beta \left(\left(1-\delta\right) \mathrm{E}_t \left[\lambda_{t+1}^{\mathrm{CONSUMER}^{*^2}}\right] + \mathrm{E}_t \left[\lambda_{t+1}^{\mathrm{c}^*} \left(r_{t+1}^* - \psi \left(-\delta + {K_t^*}^{-1} I_{t+1}^*\right)^2 + 2\psi {K_t^*}^{-1} I_{t+1}^* \left(-\delta + {K_t^*}^{-1} I_{t+1}^*\right)\right)\right]\right) = 0 \quad \left(K_t^*\right) \tag{3.4}$$

$$-\lambda_t^{\mathrm{c}^*} + \mu C_t^{*-1+\mu} (1-H_t^*)^{1-\mu} \left(C_t^{*\mu} (1-H_t^*)^{1-\mu}\right)^{-\eta} = 0 \quad \left(C_t^*\right) \tag{3.5}$$

$$\lambda_t^{\mathrm{c}^*} W_t^* + \left(-1+\mu\right) C_t^{*\mu} (1-H_t^*)^{-\mu} \left(C_t^{*\mu} (1-H_t^*)^{1-\mu}\right)^{-\eta} = 0 \quad \left(H_t^*\right) \tag{3.6}$$

$$\lambda_t^{\mathrm{CONSUMER}^{*^2}} + \lambda_t^{\mathrm{c}^*} \left(-1 - 2\psi \left(-\delta + {K_{t-1}^*}^{-1} I_t^*\right)\right) = 0 \quad \left(I_t^*\right) \tag{3.7}$$

4 FIRM*

4.1 Optimisation problem

$$\max_{K_t^{\mathrm{d}^*}, H_t^{\mathrm{d}^*}, Y_t^*, \pi_t^*} \Pi_t^* = \pi_t^* \tag{4.1}$$

s.t. :

$$Y_t^* = Z_t^* {H_t^{\mathrm{d}^*}}^{1-\alpha} {K_t^{\mathrm{d}^*}}^{\alpha} \quad \left(\lambda_t^{\mathrm{FIRM}^{*1}}\right) \tag{4.2}$$

$$\pi_t^* = Y_t^* - H_t^{\mathrm{d}^*} W_t^* - r_t^* K_t^{\mathrm{d}^*} \quad \left(\lambda_t^{\mathrm{FIRM}^{*2}}\right) \tag{4.3}$$

4.2 First order conditions

$$-\lambda_t^{\mathrm{FIRM}^{*2}} r_t^* + \alpha \lambda_t^{\mathrm{FIRM}^{*1}} Z_t^* {H_t^{\mathrm{d}^*}}^{1-\alpha} {K_t^{\mathrm{d}^*}}^{-1+\alpha} = 0 \quad \left(K_t^{\mathrm{d}^*}\right) \tag{4.4}$$

$$-\lambda_t^{\mathrm{FIRM}^{*2}} W_t^* + \lambda_t^{\mathrm{FIRM}^{*1}} Z_t^* (1-\alpha) {H_t^{\mathrm{d}^*}}^{-\alpha} {K_t^{\mathrm{d}^*}}^{\alpha} = 0 \quad \left(H_t^{\mathrm{d}^*}\right) \tag{4.5}$$

$$-\lambda_t^{\mathrm{FIRM}^{*1}} + \lambda_t^{\mathrm{FIRM}^{*2}} = 0 \quad (Y_t^*) \tag{4.6}$$

$$1 - \lambda_t^{\mathrm{FIRM}^{*2}} = 0 \quad (\pi_t^*) \tag{4.7}$$

4.3 First order conditions after reduction

$$-r_t^* + \alpha Z_t^* {H_t^{\mathrm{d}^*}}^{1-\alpha} {K_t^{\mathrm{d}^*}}^{-1+\alpha} = 0 \quad \left(K_t^{\mathrm{d}^*}\right) \tag{4.8}$$

$$-W_t^* + Z_t^* (1-\alpha) {H_t^{\mathrm{d}^*}}^{-\alpha} {K_t^{\mathrm{d}^*}}^{\alpha} = 0 \quad \left(H_t^{\mathrm{d}^*}\right) \tag{4.9}$$

5 EQUILIBRIUM

5.1 Identities

$$K_t^{\mathrm{d}} = K_{t-1} \tag{5.1}$$

$$H_t^{\mathrm{d}} = H_t \tag{5.2}$$

$$T_t = G_t^{\mathrm{d}} \tag{5.3}$$

$$K_t^{\mathrm{d}^*} = K_{t-1}^* \tag{5.4}$$

$$H_t^{\mathrm{d}^*} = H_t^* \tag{5.5}$$

$$T_t^* = G_t^{\mathrm{d}^*} \tag{5.6}$$

$$\lambda_t^{\mathrm{c}} = \lambda_t^{\mathrm{c}^*} \tag{5.7}$$

6 EXOG

6.1 Identities

$$G_t^{\mathrm{d}} = \epsilon_t^{\mathrm{G}} + \phi^{\mathrm{G}} G_{t-1}^{\mathrm{d}} \tag{6.1}$$

$$Z_t = e^{\epsilon_t^{\mathrm{Z}} + \phi^{\mathrm{Z}} \log Z_{t-1}} \tag{6.2}$$

$$G_t^{\mathrm{d}^*} = \epsilon_t^{\mathrm{G}^*} + \phi^{\mathrm{G}} G_{t-1}^{\mathrm{d}^*} \tag{6.3}$$

$$Z_t^* = e^{\epsilon_t^{\mathrm{Z}^*} + \phi^{\mathrm{Z}} \log Z_{t-1}^*} \tag{6.4}$$

7 Equilibrium relationships (after reduction)

$$-\lambda_t^{\mathrm{c}} + \mu {C_t}^{-1+\mu} (1 - H_t)^{1-\mu} \left({C_t}^{\mu} (1 - H_t)^{1-\mu} \right)^{-\eta} = 0 \tag{7.1}$$

$$\lambda_t^{\mathrm{c}} - \lambda_t^{\mathrm{c}^*} = 0 \tag{7.2}$$

$$-\lambda_t^{\mathrm{c}^*} + \mu {C_t^*}^{-1+\mu} (1 - H_t^*)^{1-\mu} \left((1 - H_t^*)^{1-\mu} {C_t^*}^{\mu} \right)^{-\eta} = 0 \tag{7.3}$$

$$-r_t + \alpha Z_t {K_{t-1}}^{-1+\alpha} {H_t}^{1-\alpha} = 0 \tag{7.4}$$

$$-r_t^* + \alpha Z_t^* {K_{t-1}^*}^{-1+\alpha} {H_t^*}^{1-\alpha} = 0 \tag{7.5}$$

$$-W_t + Z_t \left(1 - \alpha\right) {K_{t-1}}^{\alpha} {H_t}^{-\alpha} = 0 \tag{7.6}$$

$$-W_t^* + Z_t^* \left(1-\alpha\right) {K_{t-1}^*}^{\alpha} {H_t^*}^{-\alpha} = 0 \tag{7.7}$$

$$-Y_t + Z_t {K_{t-1}}^{\alpha} {H_t}^{1-\alpha} = 0 \tag{7.8}$$

$$-Y_t^* + Z_t^* {K_{t-1}^*}^{\alpha} {H_t^*}^{1-\alpha} = 0 \tag{7.9}$$

$$Z_t - e^{\epsilon_t^{\mathrm{Z}} + \phi^{\mathrm{Z}} \log Z_{t-1}} = 0 \tag{7.10}$$

$$Z_t^* - e^{\epsilon_t^{\mathrm{Z}^*} + \phi^{\mathrm{Z}} \log Z_{t-1}^*} = 0 \tag{7.11}$$

$$\beta \left(-\left(1-\delta\right) \mathrm{E}_t \left[\lambda_{t+1}^{\mathrm{c}} \left(-1 - 2\psi \left(-\delta + {K_t}^{-1} I_{t+1} \right) \right) \right] + \mathrm{E}_t \left[\lambda_{t+1}^{\mathrm{c}} \left(r_{t+1} - \psi \left(-\delta + {K_t}^{-1} I_{t+1} \right)^2 + 2\psi {K_t}^{-1} I_{t+1} \left(-\delta + {K_t}^{-1} I_{t+1} \right) \right) \right] \right) + \lambda_t^{\mathrm{c}} \left(-1 - 2\psi \left(-\delta + {K_{t-1}}^{-1} I_t \right) \right) = 0 \tag{7.12}$$

$$\beta \left(-\left(1-\delta\right) \mathrm{E}_t \left[\lambda_{t+1}^{\mathrm{c}^*} \left(-1 - 2\psi \left(-\delta + K_t^{*-1} I_{t+1}^* \right) \right) \right] + \mathrm{E}_t \left[\lambda_{t+1}^{\mathrm{c}^*} \left(r_{t+1}^* - \psi \left(-\delta + K_t^{*-1} I_{t+1}^* \right)^2 + 2\psi K_t^{*-1} I_{t+1}^* \left(-\delta + K_t^{*-1} I_{t+1}^* \right) \right) \right] \right) + \lambda_t^{\mathrm{c}^*} \left(-1 - 2\psi \left(-\delta + {K_{t-1}^*}^{-1} I_t^* \right) \right) = 0 \tag{7.13}$$

$$\lambda_t^{\mathrm{c}} W_t + \left(-1+\mu\right) {C_t}^{\mu} (1-H_t)^{-\mu} \left({C_t}^{\mu} (1-H_t)^{1-\mu} \right)^{-\eta} = 0 \tag{7.14}$$

$$\lambda_t^{\mathrm{c}^*} W_t^* + \left(-1+\mu\right) C_t^{*\mu} (1-H_t^*)^{-\mu} \left((1-H_t^*)^{1-\mu} C_t^{*\mu} \right)^{-\eta} = 0 \tag{7.15}$$

$$-\epsilon_t^{\mathrm{G}} + G_t^{\mathrm{d}} - \phi^{\mathrm{G}} G_{t-1}^{\mathrm{d}} = 0 \tag{7.16}$$

$$-\epsilon_t^{\mathrm{G}^*} + G_t^{\mathrm{d}^*} - \phi^{\mathrm{G}} G_{t-1}^{\mathrm{d}^*} = 0 \tag{7.17}$$

$$I_t - K_t + K_{t-1} \left(1-\delta\right) = 0 \tag{7.18}$$

$$I_t^* - K_t^* + K_{t-1}^* \left(1-\delta\right) = 0 \tag{7.19}$$

$$U_t - \beta \mathrm{E}_t \left[U_{t+1} \right] - \left(1-\eta\right)^{-1} \left({C_t}^{\mu} (1-H_t)^{1-\mu} \right)^{1-\eta} = 0 \tag{7.20}$$

$$U_t^* - \beta \mathrm{E}_t \left[U_{t+1}^* \right] - (1-\eta)^{-1} \left(C_t^{*\mu} (1 - H_t^*)^{1-\mu} \right)^{1-\eta} = 0 \tag{7.21}$$

$$-C_t - G_t^{\mathrm{d}} - I_t + TR_t + Y_t - \psi K_{t-1} \left(-\delta + {K_{t-1}}^{-1} I_t \right)^2 = 0 \tag{7.22}$$

$$-C_t^* - G_t^{\mathrm{d}^*} - I_t^* - TR_t + Y_t^* - \psi K_{t-1}^* \left(-\delta + {K_{t-1}^*}^{-1} I_t^* \right)^2 = 0 \tag{7.23}$$

8 Steady state relationships (after reduction)

$$-\lambda_{\mathrm{ss}}^{\mathrm{c}} + \mu {C_{\mathrm{ss}}}^{-1+\mu} (1 - H_{\mathrm{ss}})^{1-\mu} \left((1 - H_{\mathrm{ss}})^{1-\mu} {C_{\mathrm{ss}}}^{\mu} \right)^{-\eta} = 0 \tag{8.1}$$

$$\lambda_{\mathrm{ss}}^{\mathrm{c}} - \lambda_{\mathrm{ss}}^{\mathrm{c}^*} = 0 \tag{8.2}$$

$$-\lambda_{\mathrm{ss}}^{\mathrm{c}^*} + \mu {C_{\mathrm{ss}}^*}^{-1+\mu} (1 - H_{\mathrm{ss}}^*)^{1-\mu} \left(C_{\mathrm{ss}}^{*\,\mu} (1 - H_{\mathrm{ss}}^*)^{1-\mu} \right)^{-\eta} = 0 \tag{8.3}$$

$$-r_{\mathrm{ss}} + \alpha Z_{\mathrm{ss}} {H_{\mathrm{ss}}}^{1-\alpha} {K_{\mathrm{ss}}}^{-1+\alpha} = 0 \tag{8.4}$$

$$-r_{\mathrm{ss}}^* + \alpha Z_{\mathrm{ss}}^* {H_{\mathrm{ss}}^*}^{1-\alpha} {K_{\mathrm{ss}}^*}^{-1+\alpha} = 0 \tag{8.5}$$

$$-W_{\mathrm{ss}} + Z_{\mathrm{ss}} (1-\alpha) {H_{\mathrm{ss}}}^{-\alpha} {K_{\mathrm{ss}}}^{\alpha} = 0 \tag{8.6}$$

$$-W_{\mathrm{ss}}^* + Z_{\mathrm{ss}}^* (1-\alpha) {H_{\mathrm{ss}}^*}^{-\alpha} {K_{\mathrm{ss}}^*}^{\alpha} = 0 \tag{8.7}$$

$$-Y_{\mathrm{ss}} + Z_{\mathrm{ss}} {H_{\mathrm{ss}}}^{1-\alpha} {K_{\mathrm{ss}}}^{\alpha} = 0 \tag{8.8}$$

$$-Y_{\mathrm{ss}}^* + Z_{\mathrm{ss}}^* {H_{\mathrm{ss}}^*}^{1-\alpha} {K_{\mathrm{ss}}^*}^{\alpha} = 0 \tag{8.9}$$

$$Z_{\mathrm{ss}} - e^{\phi^{\mathrm{Z}} \log Z_{\mathrm{ss}}} = 0 \tag{8.10}$$

$$Z_{\mathrm{ss}}^* - e^{\phi^{\mathrm{Z}} \log Z_{\mathrm{ss}}^*} = 0 \tag{8.11}$$

$$\beta \left(\lambda_{\mathrm{ss}}^{\mathrm{c}} \left(r_{\mathrm{ss}} - \psi \left(-\delta + I_{\mathrm{ss}} {K_{\mathrm{ss}}}^{-1} \right)^2 + 2\psi I_{\mathrm{ss}} {K_{\mathrm{ss}}}^{-1} \left(-\delta + I_{\mathrm{ss}} {K_{\mathrm{ss}}}^{-1} \right) \right) - \lambda_{\mathrm{ss}}^{\mathrm{c}} \left(-1 - 2\psi \left(-\delta + I_{\mathrm{ss}} {K_{\mathrm{ss}}}^{-1} \right) \right) (1-\delta) \right) + \lambda_{\mathrm{ss}}^{\mathrm{c}} \left(-1 - 2\psi \left(-\delta + I_{\mathrm{ss}} {K_{\mathrm{ss}}}^{-1} \right) \right) = 0 \tag{8.12}$$

$$\beta\left(\lambda_{\mathrm{ss}}^{\mathrm{c}^*}\left(r_{\mathrm{ss}}^*-\psi\left(-\delta+I_{\mathrm{ss}}^*{K_{\mathrm{ss}}^*}^{-1}\right)^2+2\psi I_{\mathrm{ss}}^*{K_{\mathrm{ss}}^*}^{-1}\left(-\delta+I_{\mathrm{ss}}^*{K_{\mathrm{ss}}^*}^{-1}\right)\right)-\lambda_{\mathrm{ss}}^{\mathrm{c}^*}\left(-1-2\psi\left(-\delta+I_{\mathrm{ss}}^*{K_{\mathrm{ss}}^*}^{-1}\right)\right)(1-\delta)\right)+\lambda_{\mathrm{ss}}^{\mathrm{c}^*}\left(-1-2\psi\left(-\delta+I_{\mathrm{ss}}^*{K_{\mathrm{ss}}^*}^{-1}\right)\right)=0 \tag{8.13}$$

$$\lambda_{\mathrm{ss}}^{\mathrm{c}}W_{\mathrm{ss}}+(-1+\mu)\,{C_{\mathrm{ss}}}^{\mu}(1-H_{\mathrm{ss}})^{-\mu}\left({C_{\mathrm{ss}}}^{\mu}(1-H_{\mathrm{ss}})^{1-\mu}\right)^{-\eta}=0 \tag{8.14}$$

$$\lambda_{\mathrm{ss}}^{\mathrm{c}^*}W_{\mathrm{ss}}^*+(-1+\mu)\,{C_{\mathrm{ss}}^*}^{\mu}(1-H_{\mathrm{ss}}^*)^{-\mu}\left({C_{\mathrm{ss}}^*}^{\mu}(1-H_{\mathrm{ss}}^*)^{1-\mu}\right)^{-\eta}=0 \tag{8.15}$$

$$G_{\mathrm{ss}}^{\mathrm{d}}-\phi^{\mathrm{G}}G_{\mathrm{ss}}^{\mathrm{d}}=0 \tag{8.16}$$

$$G_{\mathrm{ss}}^{\mathrm{d}^*}-\phi^{\mathrm{G}}G_{\mathrm{ss}}^{\mathrm{d}^*}=0 \tag{8.17}$$

$$I_{\mathrm{ss}}-K_{\mathrm{ss}}+K_{\mathrm{ss}}\,(1-\delta)=0 \tag{8.18}$$

$$I_{\mathrm{ss}}^*-K_{\mathrm{ss}}^*+K_{\mathrm{ss}}^*\,(1-\delta)=0 \tag{8.19}$$

$$U_{\mathrm{ss}}-\beta U_{\mathrm{ss}}-(1-\eta)^{-1}\left({C_{\mathrm{ss}}}^{\mu}(1-H_{\mathrm{ss}})^{1-\mu}\right)^{1-\eta}=0 \tag{8.20}$$

$$U_{\mathrm{ss}}^*-\beta U_{\mathrm{ss}}^*-(1-\eta)^{-1}\left((1-H_{\mathrm{ss}}^*)^{1-\mu}{C_{\mathrm{ss}}^*}^{\mu}\right)^{1-\eta}=0 \tag{8.21}$$

$$-C_{\mathrm{ss}}-G_{\mathrm{ss}}^{\mathrm{d}}-I_{\mathrm{ss}}+TR_{\mathrm{ss}}+Y_{\mathrm{ss}}-\psi K_{\mathrm{ss}}\left(-\delta+I_{\mathrm{ss}}{K_{\mathrm{ss}}}^{-1}\right)^2=0 \tag{8.22}$$

$$-C_{\mathrm{ss}}^*-G_{\mathrm{ss}}^{\mathrm{d}^*}-I_{\mathrm{ss}}^*-TR_{\mathrm{ss}}+Y_{\mathrm{ss}}^*-\psi K_{\mathrm{ss}}^*\left(-\delta+I_{\mathrm{ss}}^*{K_{\mathrm{ss}}^*}^{-1}\right)^2=0 \tag{8.23}$$

9 Parameter settings

$$\alpha=0.4 \tag{9.1}$$

$$\beta=0.99 \tag{9.2}$$

$$\delta=0.025 \tag{9.3}$$

$$\eta = 2 \tag{9.4}$$

$$\mu = 0.3 \tag{9.5}$$

$$\phi^{\mathrm{G}} = 0.95 \tag{9.6}$$

$$\phi^{\mathrm{Z}} = 0.95 \tag{9.7}$$

$$\psi = 0.8 \tag{9.8}$$

∞

10 Steady-state values

	Steady-state values
λ^{c}	0.3934
λ^{c^*}	0.3934
r	0.0351
r^*	0.0351
C	0.9578
C^*	0.9578
G^{d}	0
G^{d^*}	0
H	0.2645
H^*	0.2645
I	0.3816
I^*	0.3816
K	15.2627
K^*	15.2627
TR	0
U	-125.6048
U^*	-125.6048
W	3.0384
W^*	3.0384
Y	1.3393
Y^*	1.3393
Z	1
Z^*	1

11 The solution of the perturbation

11.1 P

$$
\begin{array}{c}
 \\
G^{\mathrm{d}} \\
G^{\mathrm{d}^*} \\
K \\
K^* \\
Z \\
Z^*
\end{array}
\begin{array}{c}
\begin{array}{cccccc}
G^{\mathrm{d}}_{t-1} & G^{\mathrm{d}^*}_{t-1} & K_{t-1} & K^*_{t-1} & Z_{t-1} & Z^*_{t-1}
\end{array} \\
\left(\begin{array}{cccccc}
0.95 & 0 & 0 & 0 & 0 & 0 \\
0 & 0.95 & 0 & 0 & 0 & 0 \\
-0.1542 & -0.1542 & 0.9454 & 0.0244 & 2.2856 & -1.0704 \\
-0.1542 & -0.1542 & 0.0244 & 0.9454 & -1.0704 & 2.2856 \\
0 & 0 & 0 & 0 & 0.95 & 0 \\
0 & 0 & 0 & 0 & 0 & 0.95
\end{array}\right)
\end{array}
$$

11.2 Q

$$
\begin{array}{c}
 \\
G^{\mathrm{d}} \\
G^{\mathrm{d}^*} \\
K \\
K^* \\
Z \\
Z^*
\end{array}
\begin{array}{c}
\begin{array}{cccc}
\epsilon^{\mathrm{Z}} & \epsilon^{\mathrm{G}} & \epsilon^{\mathrm{G}^*} & \epsilon^{\mathrm{Z}^*}
\end{array} \\
\left(\begin{array}{cccc}
0 & 1 & 0 & 0 \\
0 & 0 & 1 & 0 \\
2.4059 & -0.1623 & -0.1623 & -1.1267 \\
-1.1267 & -0.1623 & -0.1623 & 2.4059 \\
1 & 0 & 0 & 0 \\
0 & 0 & 0 & 1
\end{array}\right)
\end{array}
$$

11.3 R

	G^{d}_{t-1}	$G^{\mathrm{d}^*}_{t-1}$	K_{t-1}	K^*_{t-1}	Z_{t-1}	Z^*_{t-1}
λ^{c}	0.1022	0.1022	−0.0091	−0.0091	−0.1072	−0.1072
λ^{c^*}	0.1022	0.1022	−0.0091	−0.0091	−0.1072	−0.1072
r	0.0044	0.0044	−0.0012	−0.0004	0.0497	−0.0046
r^*	0.0044	0.0044	−0.0004	−0.0012	−0.0046	0.0497
C	−0.1525	−0.1525	0.0187	0.0136	0.3448	0.1599
C^*	−0.1525	−0.1525	0.0136	0.0187	0.1599	0.3448
H	0.0554	0.0554	0.0023	−0.0049	0.2054	−0.0581
H^*	0.0554	0.0554	−0.0049	0.0023	−0.0581	0.2054
I	−0.1542	−0.1542	−0.0296	0.0244	2.2856	−1.0704
I^*	−0.1542	−0.1542	0.0244	−0.0296	−1.0704	2.2856
TR	0.475	−0.475	−0.053	0.053	0.7338	−0.7338
U	−3.1408	−3.1408	0.1608	0.2366	0.053	8.3603
U^*	−3.1408	−3.1408	0.2366	0.1608	8.3603	0.053
W	−0.2547	−0.2547	0.0689	0.0227	1.9424	0.2672
W^*	−0.2547	−0.2547	0.0227	0.0689	0.2672	1.9424
Y	0.1684	0.1684	0.0422	−0.015	1.8966	−0.1767
Y^*	0.1684	0.1684	−0.015	0.0422	−0.1767	1.8966

11.4 S

	ϵ^{Z}	ϵ^{G}	ϵ^{G^*}	ϵ^{Z^*}
λ^{c}	−0.1128	0.1075	0.1075	−0.1128
λ^{c^*}	−0.1128	0.1075	0.1075	−0.1128
r	0.0523	0.0046	0.0046	−0.0049
r^*	−0.0049	0.0046	0.0046	0.0523
C	0.3629	−0.1605	−0.1605	0.1683
C^*	0.1683	−0.1605	−0.1605	0.3629
H	0.2163	0.0583	0.0583	−0.0612
H^*	−0.0612	0.0583	0.0583	0.2163
I	2.4059	−0.1623	−0.1623	−1.1267
I^*	−1.1267	−0.1623	−0.1623	2.4059
TR	0.7724	0.5	−0.5	−0.7724
U	0.0557	−3.3061	−3.3061	8.8003
U^*	8.8003	−3.3061	−3.3061	0.0557
W	2.0446	−0.2681	−0.2681	0.2812
W^*	0.2812	−0.2681	−0.2681	2.0446
Y	1.9964	0.1773	0.1773	−0.186
Y^*	−0.186	0.1773	0.1773	1.9964

12 Statistics of the model

12.1 Moments

	Steady-state value	Std. dev.	Variance	Loglinear
r	0.0351	0.0051	0	N
C	0.9578	0.0373	0.0014	N
G^{d}	0	0.0922	0.0085	N
H	0.2645	0.026	0.0007	N
I	0.3816	0.2659	0.0707	N
K	15.2627	0.9072	0.8231	N
TR	0	0.1943	0.0378	N
U	-125.6048	1.065	1.1342	N
W	3.0384	0.1882	0.0354	N
Y	1.3393	0.2048	0.042	N
Z	1	0.0922	0.0085	N

12.2 Correlation matrix

	r	C	G^{d}	H	I	K	TR	U	W	Y	Z
λ^{c}	-0.1448	-0.8743	0.2572	0.1061	-0.0803	-0.0047	-0.0187	-0.7069	-0.4894	-0.1301	-0.2886
λ^{c^*}	-0.1448	-0.8743	0.2572	0.1061	-0.0803	-0.0047	-0.0187	-0.7069	-0.4894	-0.1301	-0.2886
r	1	0.5686	0.5522	0.8902	0.8158	0.1686	0.5159	-0.2367	0.8651	0.9218	0.9793
r^*	-0.0679	0.2	0.0324	-0.139	-0.6152	-0.1951	-0.7139	0.8085	0.0465	-0.0704	-0.0241
C	0.5686	1	0.0547	0.3898	0.4323	0.2641	0.1824	0.431	0.8511	0.5949	0.7017
C^*	0.0628	0.6885	-0.159	-0.2094	-0.2594	-0.2444	-0.2905	0.9396	0.3136	-0.0074	0.166
G^{d}	0.5522	0.0547	1	0.6002	0.3541	0.1369	0.4025	-0.2867	0.3765	0.5378	0.5
G^{d^*}	0.0645	-0.2751	0	0.1266	-0.3462	-0.1539	-0.5693	0.1362	-0.1009	0.0404	0
H	0.8902	0.3898	0.6002	1	0.7333	0.5322	0.3383	-0.4582	0.8152	0.9721	0.89
H^*	-0.0883	0.0506	0.0674	-0.2437	-0.6045	-0.4681	-0.575	0.764	-0.1071	-0.1999	-0.0989
I	0.8158	0.4323	0.3541	0.7333	1	0.2308	0.8288	-0.5626	0.6899	0.7501	0.7926
I^*	-0.3991	0.0775	-0.2022	-0.447	-0.8206	-0.2188	-0.8136	0.8737	-0.2061	-0.3705	-0.3347
K	0.1686	0.2641	0.1369	0.5322	0.2308	1	-0.1291	-0.3286	0.4695	0.5318	0.2956
K^*	-0.1002	0.0352	-0.0895	-0.4653	-0.1569	-0.8034	0.1682	0.4588	-0.2431	-0.3971	-0.1612
TR	0.5159	0.1824	0.4025	0.3383	0.8288	-0.1291	1	-0.5174	0.3076	0.3418	0.4493
U	-0.2367	0.431	-0.2867	-0.4582	-0.5626	-0.3286	-0.5174	1	0.0099	-0.2901	-0.1453
U^*	0.6951	0.838	0.1218	0.5844	0.8091	0.3957	0.5633	-0.0972	0.8602	0.7235	0.7851
W	0.8651	0.8511	0.3765	0.8152	0.6899	0.4695	0.3076	0.0099	1	0.9283	0.9487
W^*	-0.0133	0.4075	-0.0512	-0.2479	-0.4714	-0.3891	-0.4725	0.9335	0.1149	-0.1126	0.038
Y	0.9218	0.5949	0.5378	0.9721	0.7501	0.5318	0.3418	-0.2901	0.9283	1	0.9555
Y^*	-0.0597	0.197	0.0206	-0.2508	-0.5635	-0.4462	-0.5459	0.8497	-0.0191	-0.1687	-0.0453
Z	0.9793	0.7017	0.5	0.89	0.7926	0.2956	0.4493	-0.1453	0.9487	0.9555	1
Z^*	-0.0479	0.2874	0	-0.1857	-0.5731	-0.277	-0.6354	0.878	0.0749	-0.0889	0

12.3 Autocorrelations

	$t-1$	$t-2$	$t-3$	$t-4$	$t-5$
r	0.7037	0.4562	0.2539	0.0927	-0.0317
C	0.7464	0.5237	0.3324	0.1718	0.0405
G^{d}	0.7133	0.4711	0.2711	0.1098	-0.0163
H	0.7547	0.5359	0.3455	0.1836	0.0497
I	0.6973	0.4462	0.2424	0.0814	-0.0418
K	0.9563	0.8517	0.7083	0.544	0.3729
TR	0.7199	0.4816	0.2831	0.1217	-0.0057
U	0.7314	0.4998	0.3042	0.1431	0.0138
W	0.7473	0.5247	0.3329	0.1715	0.0394
Y	0.7516	0.5312	0.34	0.1783	0.0449
Z	0.7133	0.4711	0.2711	0.1098	-0.0163

12.4 Variance decomposition

	ϵ^{Z}	ϵ^{G}	ϵ^{G^*}	ϵ^{Z^*}
r	0.9794	0.0054	0.0057	0.0095
C	0.5466	0.1185	0.0759	0.2589
G^{d}	0.25	0.75	0	0
H	0.8104	0.0321	0.0294	0.1281
I	0.6413	0.0024	0.1258	0.2305
K	0.6482	0.0026	0.1239	0.2253
TR	0.2911	0.0422	0.3687	0.298
U	0.0221	0.0614	0.0215	0.895
W	0.9496	0.0133	0.0138	0.0233
Y	0.9443	0.0048	0.0113	0.0396
Z	1	0	0	0

13 Statistics of the model

13.1 Moments relative to moments of the reference variable

	Steady-state value relative to Y	Std. dev. relative to Y	Variance relative to Y	Loglinear
λ^{c}	0.2937	0.0901	0.0081	N
λ^{c^*}	0.2937	0.0901	0.0081	N
r	0.0262	0.0249	0.0006	N
r^*	0.0262	0.035	0.0012	N
C	0.7151	0.1821	0.0332	N
C^*	0.7151	0.2229	0.0497	N
G^{d}	0	0.4499	0.2024	N
G^{d^*}	0	0.6363	0.4049	N
H	0.1975	0.1268	0.0161	N
H^*	0.1975	0.1684	0.0283	N
I	0.2849	1.2983	1.6855	N
I^*	0.2849	1.5717	2.4701	N
K	11.3957	4.4289	19.615	N
K^*	11.3957	5.381	28.9555	N
TR	0	0.9485	0.8997	N
U	-93.7814	5.1989	27.0286	N
U^*	-93.7814	4.1109	16.8995	N
W	2.2686	0.9187	0.8439	N
W^*	2.2686	1.281	1.6408	N
Y	1	1	1	N
Y^*	1	1.387	1.9236	N
Z	0.7466	0.4499	0.2024	N
Z^*	0.7466	0.6363	0.4049	N

13.2 Correlations with the reference variable

	Y_{t-5}	Y_{t-4}	Y_{t-3}	Y_{t-2}	Y_{t-1}	Y_t	Y_{t+1}	Y_{t+2}	Y_{t+3}	Y_{t+4}	Y_{t+5}
λ^{c}	0.0916	0.0747	0.0466	0.0049	-0.0531	-0.1301	-0.1296	-0.1232	-0.1127	-0.0994	-0.0844
λ^{c^*}	0.0916	0.0747	0.0466	0.0049	-0.0531	-0.1301	-0.1296	-0.1232	-0.1127	-0.0994	-0.0844
r	0.1626	0.2765	0.4099	0.5627	0.734	0.9218	0.5737	0.2944	0.0766	-0.0872	-0.2047
r^*	-0.1312	-0.14	-0.1413	-0.1324	-0.1099	-0.0704	0.0026	0.0552	0.0907	0.1122	0.1224
C	-0.0523	0.0267	0.1286	0.256	0.4109	0.5949	0.4729	0.3599	0.2578	0.1678	0.0905
C^*	-0.1138	-0.1178	-0.1126	-0.095	-0.0613	-0.0074	0.0122	0.0279	0.0399	0.0485	0.0539
G^{d}	0.048	0.1164	0.1992	0.2971	0.4101	0.5378	0.3679	0.2265	0.1117	0.021	-0.0483
G^{d^*}	-0.0688	-0.0646	-0.0536	-0.0339	-0.0034	0.0404	0.0468	0.0498	0.0501	0.0482	0.0449
H	0.0668	0.1964	0.352	0.5339	0.7412	0.9721	0.7231	0.5036	0.3144	0.1553	0.0251
H^*	-0.0838	-0.1155	-0.1459	-0.1723	-0.1916	-0.1999	-0.1621	-0.1234	-0.0856	-0.0504	-0.0188
I	0.1968	0.2892	0.3927	0.5058	0.6261	0.7501	0.4389	0.1931	0.0048	-0.1335	-0.2294
I^*	-0.182	-0.2276	-0.2722	-0.3132	-0.3473	-0.3705	-0.1823	-0.0376	0.0693	0.1442	0.1924
K	-0.2171	-0.1269	-0.0086	0.1399	0.3199	0.5318	0.6472	0.6876	0.6718	0.6159	0.5332
K^*	0.0348	-0.0325	-0.1112	-0.1999	-0.2963	-0.3971	-0.4404	-0.4404	-0.4091	-0.3568	-0.2917
TR	0.2346	0.2682	0.2982	0.3223	0.3379	0.3418	0.0736	-0.1192	-0.2494	-0.3285	-0.3669
U	-0.1369	-0.1765	-0.2148	-0.2489	-0.2755	-0.2901	-0.1786	-0.0871	-0.0142	0.0419	0.0832
U^*	0.0647	0.1596	0.2732	0.4055	0.5561	0.7235	0.5187	0.3431	0.196	0.0759	-0.0195
W	0.0052	0.1288	0.2816	0.4654	0.681	0.9283	0.7097	0.5134	0.3413	0.194	0.0712
W^*	-0.1083	-0.1277	-0.1413	-0.146	-0.1379	-0.1126	-0.0813	-0.0516	-0.0245	-0.0006	0.0195
Y	0.0449	0.1783	0.34	0.5312	0.7516	1	0.7516	0.5312	0.34	0.1783	0.0449
Y^*	-0.0956	-0.123	-0.1472	-0.1653	-0.1739	-0.1687	-0.1327	-0.0968	-0.0626	-0.0313	-0.0036
Z	0.1046	0.2262	0.372	0.5424	0.7374	0.9555	0.6479	0.3926	0.1859	0.0232	-0.1003
Z^*	-0.1253	-0.1386	-0.1448	-0.141	-0.1237	-0.0889	-0.0307	0.0141	0.0471	0.0701	0.0845

14 Impulse response functions

14.1 Shock ϵ^Z

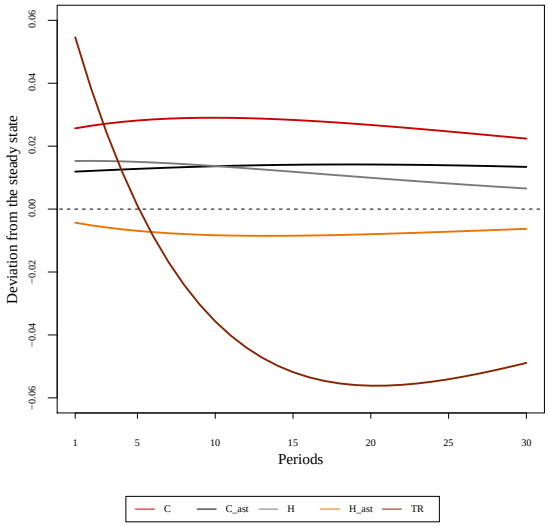

Figure 1: Impulse response function for ϵ^Z shock

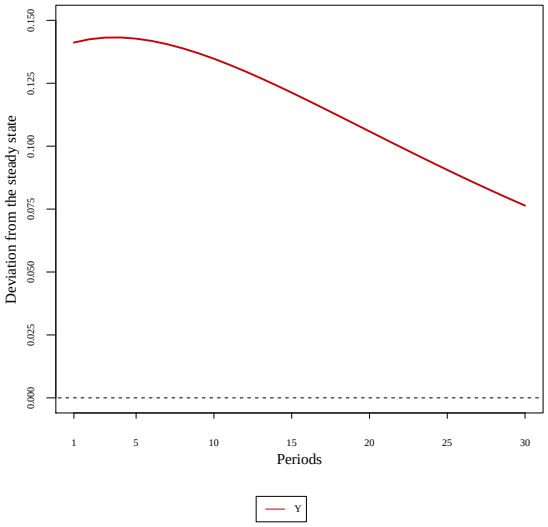

Figure 2: Impulse response function for ϵ^Z shock

14.2 Shock ϵ^{Z^*}

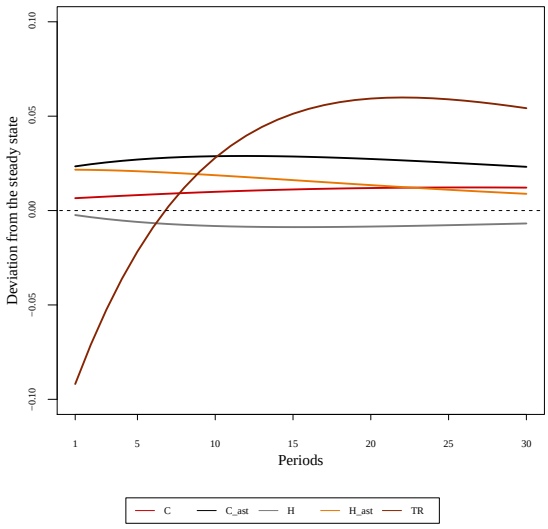

Figure 3: Impulse response function for ϵ^{Z^*} shock

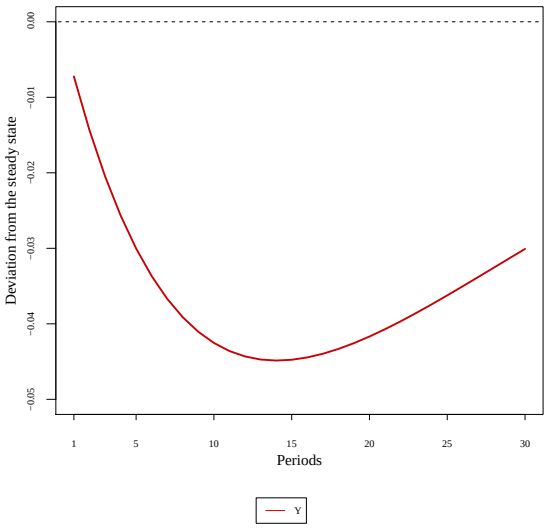

Figure 4: Impulse response function for ϵ^{Z^*} shock