

1 CONSUMER

1.1 Optimisation problem

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

s.t. :

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

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

1.2 First order conditions

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

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

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

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

2 FIRM

2.1 Optimisation problem

$$\max_{K_t^d, H_t^d, Y_t, \pi_t} \Pi_t = \pi_t \quad (2.1)$$

s.t. :

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

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

2.2 First order conditions

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

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

$$-\lambda_t^{\text{FIRM}^1} + \lambda_t^{\text{FIRM}^2} = 0 \quad (Y_t) \quad (2.6)$$

$$1 - \lambda_t^{\text{FIRM}^2} = 0 \quad (\pi_t) \quad (2.7)$$

2.3 First order conditions after reduction

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

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

3 CONSUMER*

3.1 Optimisation problem

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

s.t. :

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

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

3.2 First order conditions

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

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

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

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

4 FIRM*

4.1 Optimisation problem

$$\max_{K_t^{d*}, H_t^{d*}, Y_t^*, \pi_t^*} \Pi_t^* = \pi_t^* \quad (4.1)$$

s.t. :

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

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

4.2 First order conditions

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

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

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

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

4.3 First order conditions after reduction

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

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

5 EQUILIBRIUM

5.1 Identities

$$K_t^d = K_{t-1} \quad (5.1)$$

$$H_t^d = H_t \quad (5.2)$$

$$T_t = G_t^d \quad (5.3)$$

$$K_t^{\text{d}*} = K_{t-1}^* \quad (5.4)$$

$$H_t^{\text{d}*} = H_t^* \quad (5.5)$$

$$T_t^* = G_t^{\text{d}*} \quad (5.6)$$

$$\lambda_t^{\text{c}} = \lambda_t^{\text{c}*} \quad (5.7)$$

6 EXOG

6.1 Identities

$$G_t^{\text{d}} = \epsilon_t^{\text{G}} + \phi^{\text{G}} G_{t-1}^{\text{d}} \quad (6.1)$$

$$Z_t = e^{\epsilon_t^{\text{Z}} + \phi^{\text{Z}} \log Z_{t-1}} \quad (6.2)$$

$$G_t^{\text{d}*} = \epsilon_t^{\text{G}*} + \phi^{\text{G}} G_{t-1}^{\text{d}*} \quad (6.3)$$

$$Z_t^* = e^{\epsilon_t^{\text{Z}*} + \phi^{\text{Z}} \log Z_{t-1}^*} \quad (6.4)$$

7 Equilibrium relationships (after reduction)

$$-\lambda_t^{\text{c}} + \lambda_t^{\text{c}*} = 0 \quad (7.1)$$

$$-\lambda_t^{\text{c}} + \mu C_t^{-1+\mu} (1 - H_t)^{1-\mu} \left(C_t^{\mu} (1 - H_t)^{1-\mu} \right)^{-\eta} = 0 \quad (7.2)$$

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

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

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

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

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

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

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

$$-Z_t + e^{\epsilon_t^Z + \phi^Z \log Z_{t-1}} = 0 \quad (7.10)$$

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

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

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

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

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

$$\epsilon_t^G - G_t^d + \phi^G G_{t-1}^d = 0 \quad (7.16)$$

$$\epsilon_t^{G*} - G_t^{d*} + \phi^G G_{t-1}^{d*} = 0 \quad (7.17)$$

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

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

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

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

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

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

8 Steady state relationships (after reduction)

$$-\lambda_{ss}^c + \lambda_{ss}^{c*} = 0 \quad (8.1)$$

$$-\lambda_{ss}^c + \mu C_{ss}^{-1+\mu} (1 - H_{ss})^{1-\mu} \left(C_{ss}^{\mu} (1 - H_{ss})^{1-\mu} \right)^{-\eta} = 0 \quad (8.2)$$

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

$$-r_{ss} + \alpha Z_{ss} H_{ss}^{1-\alpha} K_{ss}^{-1+\alpha} = 0 \quad (8.4)$$

$$-r_{ss}^* + \alpha Z_{ss}^* H_{ss}^{*1-\alpha} K_{ss}^{*-1+\alpha} = 0 \quad (8.5)$$

$$-G_{ss}^d + \phi^G G_{ss}^d = 0 \quad (8.6)$$

$$-G_{ss}^{d*} + \phi^G G_{ss}^{d*} = 0 \quad (8.7)$$

$$-W_{ss} + Z_{ss} (1 - \alpha) H_{ss}^{-\alpha} K_{ss}^{\alpha} = 0 \quad (8.8)$$

$$-W_{ss}^* + Z_{ss}^* (1 - \alpha) H_{ss}^{*-\alpha} K_{ss}^{*\alpha} = 0 \quad (8.9)$$

$$-Y_{ss} + Z_{ss} H_{ss}^{1-\alpha} K_{ss}^{\alpha} = 0 \quad (8.10)$$

$$-Y_{ss}^* + Z_{ss}^* H_{ss}^{*1-\alpha} K_{ss}^{*\alpha} = 0 \quad (8.11)$$

$$-Z_{ss} + e^{\phi^Z \log Z_{ss}} = 0 \quad (8.12)$$

$$-Z_{ss}^* + e^{\phi^Z \log Z_{ss}^*} = 0 \quad (8.13)$$

$$\beta \left(\lambda_{ss}^c \left(r_{ss} - \psi \left(-\delta + I_{ss} K_{ss}^{-1} \right)^2 + 2\psi I_{ss} K_{ss}^{-1} \left(-\delta + I_{ss} K_{ss}^{-1} \right) \right) - \lambda_{ss}^c \left(-1 - 2\psi \left(-\delta + I_{ss} K_{ss}^{-1} \right) \right) (1 - \delta) \right) + \lambda_{ss}^c \left(-1 - 2\psi \left(-\delta + I_{ss} K_{ss}^{-1} \right) \right) = 0 \quad (8.14)$$

$$\beta \left(\lambda_{ss}^{c*} \left(r_{ss}^* - \psi \left(-\delta + I_{ss}^* K_{ss}^{*-1} \right)^2 + 2\psi I_{ss}^* K_{ss}^{*-1} \left(-\delta + I_{ss}^* K_{ss}^{*-1} \right) \right) - \lambda_{ss}^{c*} \left(-1 - 2\psi \left(-\delta + I_{ss}^* K_{ss}^{*-1} \right) \right) (1 - \delta) \right) + \lambda_{ss}^{c*} \left(-1 - 2\psi \left(-\delta + I_{ss}^* K_{ss}^{*-1} \right) \right) = 0 \quad (8.15)$$

$$\lambda_{ss}^c W_{ss} + (-1 + \mu) C_{ss}^{\mu} (1 - H_{ss})^{-\mu} \left(C_{ss}^{\mu} (1 - H_{ss})^{1-\mu} \right)^{-\eta} = 0 \quad (8.16)$$

$$\lambda_{ss}^{c*} W_{ss}^* + (-1 + \mu) C_{ss}^{*\mu} (1 - H_{ss}^*)^{-\mu} \left(C_{ss}^{*\mu} (1 - H_{ss}^*)^{1-\mu} \right)^{-\eta} = 0 \quad (8.17)$$

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

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

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

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

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

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

9 Parameter settings

$$\alpha = 0.4 \quad (9.1)$$

$$\beta = 0.99 \quad (9.2)$$

$$\delta = 0.025 \quad (9.3)$$

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

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

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

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

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

10 Steady-state values

	Steady-state value
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 1st order perturbation

Matrix P

$$\begin{matrix} & G_{t-1}^d & G_{t-1}^{d*} & K_{t-1} & K_{t-1}^* & Z_{t-1} & Z_{t-1}^* \\ \begin{matrix} G_t^d \\ G_t^{d*} \\ K_t \\ K_t^* \\ Z_t \\ Z_t^* \end{matrix} & \begin{pmatrix} 0.95 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0.95 & 0 & 0 & 0 & 0 \\ -0.1542 & -0.1542 & 0.9454 & 0.0244 & 2.2856 & -1.0704 \\ -0.1542 & -0.1542 & 0.0244 & 0.9454 & -1.0704 & 2.2856 \\ 0 & 0 & 0 & 0 & 0.95 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.95 \end{pmatrix} \end{matrix}$$

Matrix Q

$$\begin{matrix} & \epsilon^Z & \epsilon^G & \epsilon^{G^*} & \epsilon^{Z^*} \\ \begin{matrix} G^d \\ G^{d*} \\ K \\ K^* \\ Z \\ Z^* \end{matrix} & \begin{pmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 2.4059 & -0.1623 & -0.1623 & -1.1267 \\ -1.1267 & -0.1623 & -0.1623 & 2.4059 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \end{matrix}$$

Matrix R

$$\begin{array}{c}
 \lambda_t^c \\
 \lambda_t^{c*} \\
 r_t \\
 r_t^* \\
 C_t \\
 C_t^* \\
 H_t \\
 H_t^* \\
 I_t \\
 I_t^* \\
 TR_t \\
 U_t \\
 U_t^* \\
 W_t \\
 W_t^* \\
 Y_t \\
 Y_t^*
 \end{array}
 \begin{pmatrix}
 G_{t-1}^d & G_{t-1}^{d*} & K_{t-1} & K_{t-1}^* & Z_{t-1} & Z_{t-1}^* \\
 0.1022 & 0.1022 & -0.0091 & -0.0091 & -0.1072 & -0.1072 \\
 0.1022 & 0.1022 & -0.0091 & -0.0091 & -0.1072 & -0.1072 \\
 0.0044 & 0.0044 & -0.0012 & -0.0004 & 0.0497 & -0.0046 \\
 0.0044 & 0.0044 & -0.0004 & -0.0012 & -0.0046 & 0.0497 \\
 -0.1525 & -0.1525 & 0.0187 & 0.0136 & 0.3448 & 0.1599 \\
 -0.1525 & -0.1525 & 0.0136 & 0.0187 & 0.1599 & 0.3448 \\
 0.0554 & 0.0554 & 0.0023 & -0.0049 & 0.2054 & -0.0581 \\
 0.0554 & 0.0554 & -0.0049 & 0.0023 & -0.0581 & 0.2054 \\
 -0.1542 & -0.1542 & -0.0296 & 0.0244 & 2.2856 & -1.0704 \\
 -0.1542 & -0.1542 & 0.0244 & -0.0296 & -1.0704 & 2.2856 \\
 0.475 & -0.475 & -0.053 & 0.053 & 0.7338 & -0.7338 \\
 -3.1408 & -3.1408 & 0.1608 & 0.2366 & 0.053 & 8.3603 \\
 -3.1408 & -3.1408 & 0.2366 & 0.1608 & 8.3603 & 0.053 \\
 -0.2547 & -0.2547 & 0.0689 & 0.0227 & 1.9424 & 0.2672 \\
 -0.2547 & -0.2547 & 0.0227 & 0.0689 & 0.2672 & 1.9424 \\
 0.1684 & 0.1684 & 0.0422 & -0.015 & 1.8966 & -0.1767 \\
 0.1684 & 0.1684 & -0.015 & 0.0422 & -0.1767 & 1.8966
 \end{pmatrix}$$

Matrix S

$$\begin{array}{c}
 \lambda^c \\
 \lambda^{c*} \\
 r \\
 r^* \\
 C \\
 C^* \\
 H \\
 H^* \\
 I \\
 I^* \\
 TR \\
 U \\
 U^* \\
 W \\
 W^* \\
 Y \\
 Y^*
 \end{array}
 \begin{pmatrix}
 \epsilon^Z & \epsilon^G & \epsilon^{G^*} & \epsilon^{Z^*} \\
 -0.1128 & 0.1075 & 0.1075 & -0.1128 \\
 -0.1128 & 0.1075 & 0.1075 & -0.1128 \\
 0.0523 & 0.0046 & 0.0046 & -0.0049 \\
 -0.0049 & 0.0046 & 0.0046 & 0.0523 \\
 0.3629 & -0.1605 & -0.1605 & 0.1683 \\
 0.1683 & -0.1605 & -0.1605 & 0.3629 \\
 0.2163 & 0.0583 & 0.0583 & -0.0612 \\
 -0.0612 & 0.0583 & 0.0583 & 0.2163 \\
 2.4059 & -0.1623 & -0.1623 & -1.1267 \\
 -1.1267 & -0.1623 & -0.1623 & 2.4059 \\
 0.7724 & 0.5 & -0.5 & -0.7724 \\
 0.0557 & -3.3061 & -3.3061 & 8.8003 \\
 8.8003 & -3.3061 & -3.3061 & 0.0557 \\
 2.0446 & -0.2681 & -0.2681 & 0.2812 \\
 0.2812 & -0.2681 & -0.2681 & 2.0446 \\
 1.9964 & 0.1773 & 0.1773 & -0.186 \\
 -0.186 & 0.1773 & 0.1773 & 1.9964
 \end{pmatrix}$$

12 Model statistics

12.1 Basic statistics

	Steady-state value	Std. dev.	Variance	Loglin
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
r	1	0.569	0.552	0.89	0.816	0.169	0.516	-0.237	0.865	0.922	0.979
C		1	0.055	0.39	0.432	0.264	0.182	0.431	0.851	0.595	0.702
G^d			1	0.6	0.354	0.137	0.403	-0.287	0.377	0.538	0.5
H				1	0.733	0.532	0.338	-0.458	0.815	0.972	0.89
I					1	0.231	0.829	-0.563	0.69	0.75	0.793
K						1	-0.129	-0.329	0.47	0.532	0.296
TR							1	-0.517	0.308	0.342	0.449
U								1	0.01	-0.29	-0.145
W									1	0.928	0.949
Y										1	0.956
Z											1

12.3 Cross correlations with the reference variable (Y)

	$\sigma[\cdot]$ rel. to $\sigma[Y]$	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}
r_t	0.025	0.163	0.276	0.41	0.563	0.734	0.922	0.574	0.294	0.077	-0.087	-0.205
C_t	0.182	-0.052	0.027	0.129	0.256	0.411	0.595	0.473	0.36	0.258	0.168	0.09
G_t^d	0.45	0.048	0.116	0.199	0.297	0.41	0.538	0.368	0.227	0.112	0.021	-0.048
H_t	0.127	0.067	0.196	0.352	0.534	0.741	0.972	0.723	0.504	0.314	0.155	0.025
I_t	1.298	0.197	0.289	0.393	0.506	0.626	0.75	0.439	0.193	0.005	-0.134	-0.229
K_t	4.429	-0.217	-0.127	-0.009	0.14	0.32	0.532	0.647	0.688	0.672	0.616	0.533
TR_t	0.949	0.235	0.268	0.298	0.322	0.338	0.342	0.074	-0.119	-0.249	-0.328	-0.367
U_t	5.199	-0.137	-0.177	-0.215	-0.249	-0.275	-0.29	-0.179	-0.087	-0.014	0.042	0.083
W_t	0.919	0.005	0.129	0.282	0.465	0.681	0.928	0.71	0.513	0.341	0.194	0.071
Y_t	1	0.045	0.178	0.34	0.531	0.752	1	0.752	0.531	0.34	0.178	0.045
Z_t	0.45	0.105	0.226	0.372	0.542	0.737	0.956	0.648	0.393	0.186	0.023	-0.1

12.4 Autocorrelations

	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5
r	0.704	0.456	0.254	0.093	0
C	0.746	0.524	0.332	0.172	0.041
G^d	0.713	0.471	0.271	0.11	-0.016
H	0.755	0.536	0.345	0.184	0.05
I	0.697	0.446	0.242	0.081	-0.042
K	0.956	0.852	0.708	0.544	0.373
TR	0.72	0.482	0.283	0.122	-0.006
U	0.731	0.5	0.304	0.143	0.014
W	0.747	0.525	0.333	0.172	0.039
Y	0.752	0.531	0.34	0.178	0.045
Z	0.713	0.471	0.271	0.11	-0.016

12.5 Variance decomposition

	ϵ^Z	ϵ^G	ϵ^{G^*}	ϵ^{Z^*}
r	0.979	0.005	0.006	0.01
C	0.547	0.119	0.076	0.259
G^d	0.25	0.75	0	0
H	0.81	0.032	0.029	0.128
I	0.641	0.002	0.126	0.23
K	0.648	0.003	0.124	0.225
TR	0.291	0.042	0.369	0.298
U	0.022	0.061	0.022	0.895
W	0.95	0.013	0.014	0.023
Y	0.944	0.005	0.011	0.04
Z	1	0	0	0

13 Impulse response functions

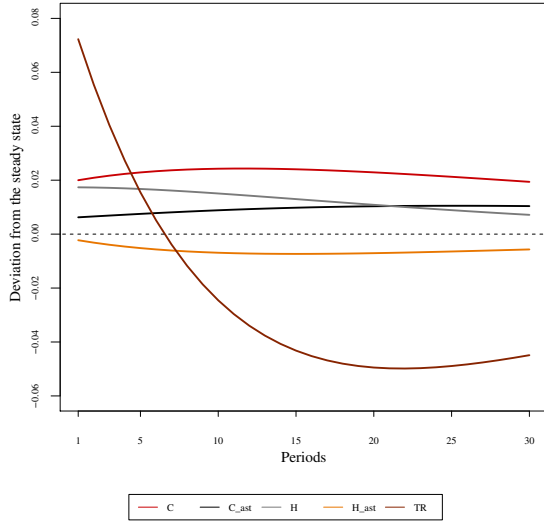


Figure 1: Impulse responses (C, C^*, H, H^*, TR) to ϵ^Z shock

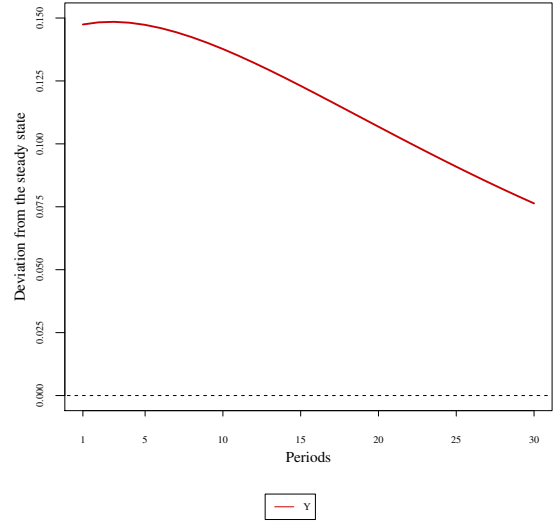


Figure 2: Impulse response (Y) to ϵ^Z shock

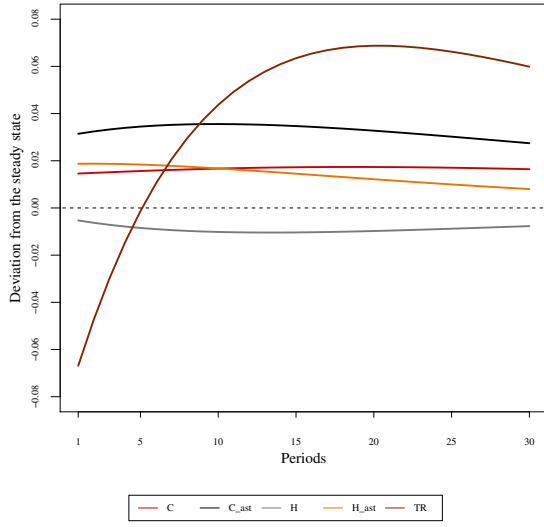


Figure 3: Impulse responses (C, C^*, H, H^*, TR) to ϵ^{Z^*} shock

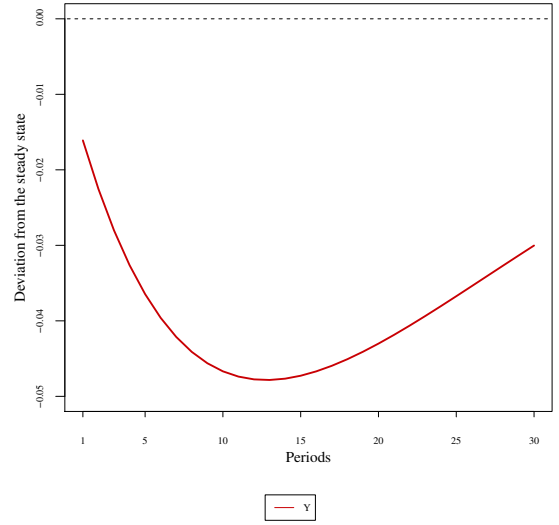


Figure 4: Impulse response (Y) to ϵ^{Z^*} shock