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Index sets

$$\mathit{COUNTRY} = \{\mathrm{F}, \mathrm{H}\}$$

1 CONSUMER $c \in \mathit{COUNTRY}$

1.1 Optimisation problem

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

s.t. :

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

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

1.2 First order conditions

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

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

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

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

2 FIRM $c \in \mathit{COUNTRY}$

2.1 Optimisation problem

$$\max_{{K^{\mathrm{d}}}_t^{\langle c \rangle}, {H^{\mathrm{d}}}_t^{\langle c \rangle}, Y_t^{\langle c \rangle}, \pi_t^{\langle c \rangle}} \Pi_t^{\langle c \rangle} = \pi_t^{\langle c \rangle} \tag{2.1}$$

s.t. :

$$Y_t^{\langle c \rangle} = Z_t^{\langle c \rangle} {{H^{\mathrm{d}}}_t^{\langle c \rangle}}^{1-\alpha^{\langle c \rangle}} {{K^{\mathrm{d}}}_t^{\langle c \rangle}}^{\alpha^{\langle c \rangle}} \quad \left({\lambda^{\mathrm{FIRM}^1}}_t^{\langle c \rangle}\right) \tag{2.2}$$

$$\pi_t^{\langle c \rangle} = Y_t^{\langle c \rangle} - {H^{\mathrm{d}}}_t^{\langle c \rangle} W_t^{\langle c \rangle} - r_t^{\langle c \rangle} {K^{\mathrm{d}}}_t^{\langle c \rangle} \quad \left({\lambda^{\mathrm{FIRM}^2}}_t^{\langle c \rangle}\right) \tag{2.3}$$

2.2 First order conditions

$$-{\lambda^{\mathrm{FIRM}^2}}_t^{\langle c \rangle} r_t^{\langle c \rangle} + \alpha^{\langle c \rangle} {\lambda^{\mathrm{FIRM}^1}}_t^{\langle c \rangle} Z_t^{\langle c \rangle} {{H^{\mathrm{d}}}_t^{\langle c \rangle}}^{1-\alpha^{\langle c \rangle}} {{K^{\mathrm{d}}}_t^{\langle c \rangle}}^{-1+\alpha^{\langle c \rangle}} = 0 \quad \left({K^{\mathrm{d}}}_t^{\langle c \rangle}\right) \tag{2.4}$$

$$-{\lambda^{\mathrm{FIRM}^2}}_t^{\langle c \rangle} W_t^{\langle c \rangle} + {\lambda^{\mathrm{FIRM}^1}}_t^{\langle c \rangle} Z_t^{\langle c \rangle} \left(1 - \alpha^{\langle c \rangle}\right) {{H^{\mathrm{d}}}_t^{\langle c \rangle}}^{-\alpha^{\langle c \rangle}} {{K^{\mathrm{d}}}_t^{\langle c \rangle}}^{\alpha^{\langle c \rangle}} = 0 \quad \left({H^{\mathrm{d}}}_t^{\langle c \rangle}\right) \tag{2.5}$$

$$-{\lambda^{\mathrm{FIRM}^1}}_t^{\langle c \rangle} + {\lambda^{\mathrm{FIRM}^2}}_t^{\langle c \rangle} = 0 \quad \left(Y_t^{\langle c \rangle}\right) \tag{2.6}$$

$$1 - {\lambda^{\mathrm{FIRM}^2}}_t^{\langle c \rangle} = 0 \quad \left(\pi_t^{\langle c \rangle}\right) \tag{2.7}$$

2.3 First order conditions after reduction

$$-r_t^{\langle c \rangle} + \alpha^{\langle c \rangle} Z_t^{\langle c \rangle} {{H^{\mathrm{d}}}_t^{\langle c \rangle}}^{1-\alpha^{\langle c \rangle}} {{K^{\mathrm{d}}}_t^{\langle c \rangle}}^{-1+\alpha^{\langle c \rangle}} = 0 \quad \left({K^{\mathrm{d}}}_t^{\langle c \rangle}\right) \tag{2.8}$$

$$-W_t^{\langle c \rangle} + Z_t^{\langle c \rangle} \left(1 - \alpha^{\langle c \rangle}\right) {{H^{\mathrm{d}}}_t^{\langle c \rangle}}^{-\alpha^{\langle c \rangle}} {{K^{\mathrm{d}}}_t^{\langle c \rangle}}^{\alpha^{\langle c \rangle}} = 0 \quad \left({H^{\mathrm{d}}}_t^{\langle c \rangle}\right) \tag{2.9}$$

3 EQUILIBRIUM

3.1 Identities

$$\sum_{c \in \mathit{COUNTRY}} TR_t^{\langle c \rangle} = 0 \tag{3.1}$$

$$c \in \mathit{COUNTRY}: \quad {K^{\mathrm{d}}}^{\langle c \rangle}_{t} = K^{\langle c \rangle}_{t-1} \tag{3.2}$$

$$c \in \mathit{COUNTRY}: \quad {H^{\mathrm{d}}}^{\langle c \rangle}_{t} = H^{\langle c \rangle}_{t} \tag{3.3}$$

$$c \in \mathit{COUNTRY}: \quad T^{\langle c \rangle}_{t} = {G^{\mathrm{d}}}^{\langle c \rangle}_{t} \tag{3.4}$$

$${\lambda^{\mathrm{c}}}^{\langle \mathrm{H} \rangle}_{t} = {\lambda^{\mathrm{c}}}^{\langle \mathrm{F} \rangle}_{t} \tag{3.5}$$

4 EXOG

4.1 Identities

$$c \in \mathit{COUNTRY}: \quad {G^{\mathrm{d}}}^{\langle c \rangle}_{t} = {\epsilon^{\mathrm{G}}}^{\langle c \rangle}_{t} + {\phi^{\mathrm{G}}}^{\langle c \rangle} {G^{\mathrm{d}}}^{\langle c \rangle}_{t-1} \tag{4.1}$$

$$c \in \mathit{COUNTRY}: \quad Z^{\langle c \rangle}_{t} = e^{{\epsilon^{\mathrm{Z}}}^{\langle c \rangle}_{t} + {\phi^{\mathrm{Z}}}^{\langle c \rangle} \log Z^{\langle c \rangle}_{t-1}} \tag{4.2}$$

5 Equilibrium relationships (before expansion and reduction)

$$-\sum_{c \in \mathit{COUNTRY}} TR^{\langle c \rangle}_{t} = 0 \tag{5.1}$$

$${\lambda^{\mathrm{c}}}^{\langle \mathrm{F} \rangle}_{t} - {\lambda^{\mathrm{c}}}^{\langle \mathrm{H} \rangle}_{t} = 0 \tag{5.2}$$

$$c \in \mathit{COUNTRY}: \quad K^{\langle c \rangle}_{t-1} - {K^{\mathrm{d}}}^{\langle c \rangle}_{t} = 0 \tag{5.3}$$

$$c \in \mathit{COUNTRY}: \quad -{\lambda^{\mathrm{CONSUMER}^2}}^{\langle c \rangle}_{t} + \beta \left(\left(1 - \delta^{\langle c \rangle}\right) \mathrm{E}_t \left[{\lambda^{\mathrm{CONSUMER}^2}}^{\langle c \rangle}_{t+1} \right] + \mathrm{E}_t \left[{\lambda^{\mathrm{c}}}^{\langle c \rangle}_{t+1} \left(r^{\langle c \rangle}_{t+1} - \psi^{\langle c \rangle} \left(-\delta^{\langle c \rangle} + {K^{\langle c \rangle}_{t}}^{-1} I^{\langle c \rangle}_{t+1} \right)^2 + 2\psi^{\langle c \rangle} {K^{\langle c \rangle}_{t}}^{-1} I^{\langle c \rangle}_{t+1} \left(-\delta^{\langle c \rangle} + {K^{\langle c \rangle}_{t}}^{-1} I^{\langle c \rangle}_{t+1} \right) \right) \right] \right) = 0 \tag{5.4}$$

$$c \in \mathit{COUNTRY}: \quad {\lambda^{\mathrm{CONSUMER}^2}}^{\langle c \rangle}_{t} + {\lambda^{\mathrm{c}}}^{\langle c \rangle}_{t} \left(-1 - 2\psi^{\langle c \rangle} \left(-\delta^{\langle c \rangle} + {K^{\langle c \rangle}_{t-1}}^{-1} I^{\langle c \rangle}_{t} \right) \right) = 0 \tag{5.5}$$

$$c \in \mathit{COUNTRY}: \quad -{\lambda^{\mathrm{c}}}^{\langle c \rangle}_{t} + \mu {C^{\langle c \rangle}_{t}}^{-1+\mu} \left(1 - H^{\langle c \rangle}_{t}\right)^{1-\mu} \left({C^{\langle c \rangle}_{t}}^{\mu} \left(1 - H^{\langle c \rangle}_{t}\right)^{1-\mu} \right)^{-\eta} = 0 \tag{5.6}$$

$$c \in \mathit{COUNTRY}: \quad -\pi^{\langle c \rangle}_{t} + \Pi^{\langle c \rangle}_{t} = 0 \tag{5.7}$$

$$c \in \mathit{COUNTRY}: \quad -r_t^{\langle c\rangle} + \alpha^{\langle c\rangle} Z_t^{\langle c\rangle} {H^{\mathrm{d}}}_t^{\langle c\rangle\,1-\alpha^{\langle c\rangle}} {K^{\mathrm{d}}}_t^{\langle c\rangle\,-1+\alpha^{\langle c\rangle}} = 0 \tag{5.8}$$

$$c \in \mathit{COUNTRY}: \quad {G^{\mathrm{d}}}_t^{\langle c\rangle} - T_t^{\langle c\rangle} = 0 \tag{5.9}$$

$$c \in \mathit{COUNTRY}: \quad H_t^{\langle c\rangle} - {H^{\mathrm{d}}}_t^{\langle c\rangle} = 0 \tag{5.10}$$

$$c \in \mathit{COUNTRY}: \quad -W_t^{\langle c\rangle} + Z_t^{\langle c\rangle} \left(1-\alpha^{\langle c\rangle}\right) {H^{\mathrm{d}}}_t^{\langle c\rangle\,-\alpha^{\langle c\rangle}} {K^{\mathrm{d}}}_t^{\langle c\rangle\,\alpha^{\langle c\rangle}} = 0 \tag{5.11}$$

$$c \in \mathit{COUNTRY}: \quad -Y_t^{\langle c\rangle} + Z_t^{\langle c\rangle} {H^{\mathrm{d}}}_t^{\langle c\rangle\,1-\alpha^{\langle c\rangle}} {K^{\mathrm{d}}}_t^{\langle c\rangle\,\alpha^{\langle c\rangle}} = 0 \tag{5.12}$$

$$c \in \mathit{COUNTRY}: \quad -Z_t^{\langle c\rangle} + e^{{\epsilon^{\mathrm{Z}}}_t^{\langle c\rangle} + \phi^{\mathrm{Z}\,\langle c\rangle} \log Z_{t-1}^{\langle c\rangle}} = 0 \tag{5.13}$$

$$c \in \mathit{COUNTRY}: \quad {\lambda^{\mathrm{c}}}_t^{\langle c\rangle} W_t^{\langle c\rangle} + (-1+\mu)\, C_t^{\langle c\rangle\,\mu} \left(1-H_t^{\langle c\rangle}\right)^{-\mu} \left(C_t^{\langle c\rangle\,\mu} \left(1-H_t^{\langle c\rangle}\right)^{1-\mu}\right)^{-\eta} = 0 \tag{5.14}$$

$$c \in \mathit{COUNTRY}: \quad {\epsilon^{\mathrm{G}}}_t^{\langle c\rangle} - {G^{\mathrm{d}}}_t^{\langle c\rangle} + \phi^{\mathrm{G}\,\langle c\rangle} {G^{\mathrm{d}}}_{t-1}^{\langle c\rangle} = 0 \tag{5.15}$$

$$c \in \mathit{COUNTRY}: \quad I_t^{\langle c\rangle} - K_t^{\langle c\rangle} + K_{t-1}^{\langle c\rangle} \left(1-\delta^{\langle c\rangle}\right) = 0 \tag{5.16}$$

$$c \in \mathit{COUNTRY}: \quad U_t^{\langle c\rangle} - \beta \mathrm{E}_t \left[U_{t+1}^{\langle c\rangle}\right] - (1-\eta)^{-1} \left(C_t^{\langle c\rangle\,\mu} \left(1-H_t^{\langle c\rangle}\right)^{1-\mu}\right)^{1-\eta} = 0 \tag{5.17}$$

$$c \in \mathit{COUNTRY}: \quad -\pi_t^{\langle c\rangle} + Y_t^{\langle c\rangle} - r_t^{\langle c\rangle} {K^{\mathrm{d}}}_t^{\langle c\rangle} - {H^{\mathrm{d}}}_t^{\langle c\rangle} W_t^{\langle c\rangle} = 0 \tag{5.18}$$

$$c \in \mathit{COUNTRY}: \quad \pi_t^{\langle c\rangle} - C_t^{\langle c\rangle} - I_t^{\langle c\rangle} - T_t^{\langle c\rangle} + TR_t^{\langle c\rangle} + K_{t-1}^{\langle c\rangle} r_t^{\langle c\rangle} + H_t^{\langle c\rangle} W_t^{\langle c\rangle} - \psi^{\langle c\rangle} K_{t-1}^{\langle c\rangle} \left(-\delta^{\langle c\rangle} + {K_{t-1}^{\langle c\rangle}}^{-1} I_t^{\langle c\rangle}\right)^2 = 0 \tag{5.19}$$

6 Equilibrium relationships (after expansion and reduction)

$$-\lambda^{\mathrm{c}\langle \mathrm{F}\rangle}_{t} + \mu {C^{\langle \mathrm{F}\rangle}_{t}}^{-1+\mu}\left(1-H^{\langle \mathrm{F}\rangle}_{t}\right)^{1-\mu}\left({C^{\langle \mathrm{F}\rangle}_{t}}^{\mu}\left(1-H^{\langle \mathrm{F}\rangle}_{t}\right)^{1-\mu}\right)^{-\eta}=0 \tag{6.1}$$

$$\lambda^{\mathrm{c}\langle \mathrm{F}\rangle}_{t} - \lambda^{\mathrm{c}\langle \mathrm{H}\rangle}_{t} = 0 \tag{6.2}$$

$$-\lambda^{\mathrm{c}\langle \mathrm{H}\rangle}_{t} + \mu {C^{\langle \mathrm{H}\rangle}_{t}}^{-1+\mu}\left(1-H^{\langle \mathrm{H}\rangle}_{t}\right)^{1-\mu}\left({C^{\langle \mathrm{H}\rangle}_{t}}^{\mu}\left(1-H^{\langle \mathrm{H}\rangle}_{t}\right)^{1-\mu}\right)^{-\eta}=0 \tag{6.3}$$

$$-r^{\langle \mathrm{F}\rangle}_{t} + \alpha^{\langle \mathrm{F}\rangle} Z^{\langle \mathrm{F}\rangle}_{t} {K^{\langle \mathrm{F}\rangle}_{t-1}}^{-1+\alpha^{\langle \mathrm{F}\rangle}} {H^{\langle \mathrm{F}\rangle}_{t}}^{1-\alpha^{\langle \mathrm{F}\rangle}} = 0 \tag{6.4}$$

$$-r^{\langle \mathrm{H}\rangle}_{t} + \alpha^{\langle \mathrm{H}\rangle} Z^{\langle \mathrm{H}\rangle}_{t} {K^{\langle \mathrm{H}\rangle}_{t-1}}^{-1+\alpha^{\langle \mathrm{H}\rangle}} {H^{\langle \mathrm{H}\rangle}_{t}}^{1-\alpha^{\langle \mathrm{H}\rangle}} = 0 \tag{6.5}$$

$$-W^{\langle \mathrm{F}\rangle}_{t} + Z^{\langle \mathrm{F}\rangle}_{t}\left(1-\alpha^{\langle \mathrm{F}\rangle}\right){K^{\langle \mathrm{F}\rangle}_{t-1}}^{\alpha^{\langle \mathrm{F}\rangle}} {H^{\langle \mathrm{F}\rangle}_{t}}^{-\alpha^{\langle \mathrm{F}\rangle}} = 0 \tag{6.6}$$

$$-W^{\langle \mathrm{H}\rangle}_{t} + Z^{\langle \mathrm{H}\rangle}_{t}\left(1-\alpha^{\langle \mathrm{H}\rangle}\right){K^{\langle \mathrm{H}\rangle}_{t-1}}^{\alpha^{\langle \mathrm{H}\rangle}} {H^{\langle \mathrm{H}\rangle}_{t}}^{-\alpha^{\langle \mathrm{H}\rangle}} = 0 \tag{6.7}$$

$$-Y^{\langle \mathrm{F}\rangle}_{t} + Z^{\langle \mathrm{F}\rangle}_{t}{K^{\langle \mathrm{F}\rangle}_{t-1}}^{\alpha^{\langle \mathrm{F}\rangle}} {H^{\langle \mathrm{F}\rangle}_{t}}^{1-\alpha^{\langle \mathrm{F}\rangle}} = 0 \tag{6.8}$$

$$-Y^{\langle \mathrm{H}\rangle}_{t} + Z^{\langle \mathrm{H}\rangle}_{t}{K^{\langle \mathrm{H}\rangle}_{t-1}}^{\alpha^{\langle \mathrm{H}\rangle}} {H^{\langle \mathrm{H}\rangle}_{t}}^{1-\alpha^{\langle \mathrm{H}\rangle}} = 0 \tag{6.9}$$

$$-Z^{\langle \mathrm{F}\rangle}_{t} + e^{\epsilon^{\mathrm{Z}\langle \mathrm{F}\rangle}_{t} + \phi^{\mathrm{Z}\langle \mathrm{F}\rangle}\log Z^{\langle \mathrm{F}\rangle}_{t-1}} = 0 \tag{6.10}$$

$$-Z^{\langle \mathrm{H}\rangle}_{t} + e^{\epsilon^{\mathrm{Z}\langle \mathrm{H}\rangle}_{t} + \phi^{\mathrm{Z}\langle \mathrm{H}\rangle}\log Z^{\langle \mathrm{H}\rangle}_{t-1}} = 0 \tag{6.11}$$

$$\beta\Bigg(-\left(1-\delta^{\langle \mathrm{F}\rangle}\right)\mathrm{E}_t\left[\lambda^{\mathrm{c}\langle \mathrm{F}\rangle}_{t+1}\left(-1-2\psi^{\langle \mathrm{F}\rangle}\left(-\delta^{\langle \mathrm{F}\rangle}+{K^{\langle \mathrm{F}\rangle}_{t}}^{-1}I^{\langle \mathrm{F}\rangle}_{t+1}\right)\right)\right] + \mathrm{E}_t\Bigg[\lambda^{\mathrm{c}\langle \mathrm{F}\rangle}_{t+1}\Bigg(r^{\langle \mathrm{F}\rangle}_{t+1} - \psi^{\langle \mathrm{F}\rangle}\left(-\delta^{\langle \mathrm{F}\rangle}+{K^{\langle \mathrm{F}\rangle}_{t}}^{-1}I^{\langle \mathrm{F}\rangle}_{t+1}\right)^2 + 2\psi^{\langle \mathrm{F}\rangle}{K^{\langle \mathrm{F}\rangle}_{t}}^{-1}I^{\langle \mathrm{F}\rangle}_{t+1}\left(-\delta^{\langle \mathrm{F}\rangle}+{K^{\langle \mathrm{F}\rangle}_{t}}^{-1}I^{\langle \mathrm{F}\rangle}_{t+1}\right)\Bigg)\Bigg]\Bigg)+\lambda^{\mathrm{c}\langle \mathrm{F}\rangle}_{t}\Big(-1-2 \tag{6.12}$$

$$\beta\Bigg(-\left(1-\delta^{\langle \mathrm{H}\rangle}\right)\mathrm{E}_t\left[\lambda^{\mathrm{c}\langle \mathrm{H}\rangle}_{t+1}\left(-1-2\psi^{\langle \mathrm{H}\rangle}\left(-\delta^{\langle \mathrm{H}\rangle}+{K^{\langle \mathrm{H}\rangle}_{t}}^{-1}I^{\langle \mathrm{H}\rangle}_{t+1}\right)\right)\right] + \mathrm{E}_t\Bigg[\lambda^{\mathrm{c}\langle \mathrm{H}\rangle}_{t+1}\Bigg(r^{\langle \mathrm{H}\rangle}_{t+1} - \psi^{\langle \mathrm{H}\rangle}\left(-\delta^{\langle \mathrm{H}\rangle}+{K^{\langle \mathrm{H}\rangle}_{t}}^{-1}I^{\langle \mathrm{H}\rangle}_{t+1}\right)^2 + 2\psi^{\langle \mathrm{H}\rangle}{K^{\langle \mathrm{H}\rangle}_{t}}^{-1}I^{\langle \mathrm{H}\rangle}_{t+1}\left(-\delta^{\langle \mathrm{H}\rangle}+{K^{\langle \mathrm{H}\rangle}_{t}}^{-1}I^{\langle \mathrm{H}\rangle}_{t+1}\right)\Bigg)\Bigg]\Bigg)+\lambda^{\mathrm{c}\langle \mathrm{H}\rangle}_{t}\Big(-1- \tag{6.13}$$

$$\lambda^{\mathrm{c}\,\langle \mathrm{F}\rangle}_{t} W^{\langle \mathrm{F}\rangle}_{t} + (-1+\mu)\, {C^{\langle \mathrm{F}\rangle}_{t}}^{\mu} \left(1 - H^{\langle \mathrm{F}\rangle}_{t}\right)^{-\mu} \left({C^{\langle \mathrm{F}\rangle}_{t}}^{\mu} \left(1 - H^{\langle \mathrm{F}\rangle}_{t}\right)^{1-\mu}\right)^{-\eta} = 0 \tag{6.14}$$

$$\lambda^{\mathrm{c}\,\langle \mathrm{H}\rangle}_{t} W^{\langle \mathrm{H}\rangle}_{t} + (-1+\mu)\, {C^{\langle \mathrm{H}\rangle}_{t}}^{\mu} \left(1 - H^{\langle \mathrm{H}\rangle}_{t}\right)^{-\mu} \left({C^{\langle \mathrm{H}\rangle}_{t}}^{\mu} \left(1 - H^{\langle \mathrm{H}\rangle}_{t}\right)^{1-\mu}\right)^{-\eta} = 0 \tag{6.15}$$

$$\epsilon^{\mathrm{G}\,\langle \mathrm{F}\rangle}_{t} - G^{\mathrm{d}\,\langle \mathrm{F}\rangle}_{t} + \phi^{\mathrm{G}\,\langle \mathrm{F}\rangle} G^{\mathrm{d}\,\langle \mathrm{F}\rangle}_{t-1} = 0 \tag{6.16}$$

$$\epsilon^{\mathrm{G}\,\langle \mathrm{H}\rangle}_{t} - G^{\mathrm{d}\,\langle \mathrm{H}\rangle}_{t} + \phi^{\mathrm{G}\,\langle \mathrm{H}\rangle} G^{\mathrm{d}\,\langle \mathrm{H}\rangle}_{t-1} = 0 \tag{6.17}$$

$$I^{\langle \mathrm{F}\rangle}_{t} - K^{\langle \mathrm{F}\rangle}_{t} + K^{\langle \mathrm{F}\rangle}_{t-1} \left(1 - \delta^{\langle \mathrm{F}\rangle}\right) = 0 \tag{6.18}$$

$$I^{\langle \mathrm{H}\rangle}_{t} - K^{\langle \mathrm{H}\rangle}_{t} + K^{\langle \mathrm{H}\rangle}_{t-1} \left(1 - \delta^{\langle \mathrm{H}\rangle}\right) = 0 \tag{6.19}$$

$$U^{\langle \mathrm{F}\rangle}_{t} - \beta \mathrm{E}_{t}\left[U^{\langle \mathrm{F}\rangle}_{t+1}\right] - (1-\eta)^{-1} \left({C^{\langle \mathrm{F}\rangle}_{t}}^{\mu} \left(1 - H^{\langle \mathrm{F}\rangle}_{t}\right)^{1-\mu}\right)^{1-\eta} = 0 \tag{6.20}$$

$$U^{\langle \mathrm{H}\rangle}_{t} - \beta \mathrm{E}_{t}\left[U^{\langle \mathrm{H}\rangle}_{t+1}\right] - (1-\eta)^{-1} \left({C^{\langle \mathrm{H}\rangle}_{t}}^{\mu} \left(1 - H^{\langle \mathrm{H}\rangle}_{t}\right)^{1-\mu}\right)^{1-\eta} = 0 \tag{6.21}$$

$$-C^{\langle \mathrm{F}\rangle}_{t} - G^{\mathrm{d}\,\langle \mathrm{F}\rangle}_{t} - I^{\langle \mathrm{F}\rangle}_{t} - TR^{\langle \mathrm{H}\rangle}_{t} + Y^{\langle \mathrm{F}\rangle}_{t} - \psi^{\langle \mathrm{F}\rangle} K^{\langle \mathrm{F}\rangle}_{t-1} \left(-\delta^{\langle \mathrm{F}\rangle} + {K^{\langle \mathrm{F}\rangle}_{t-1}}^{-1} I^{\langle \mathrm{F}\rangle}_{t}\right)^{2} = 0 \tag{6.22}$$

$$-C^{\langle \mathrm{H}\rangle}_{t} - G^{\mathrm{d}\,\langle \mathrm{H}\rangle}_{t} - I^{\langle \mathrm{H}\rangle}_{t} + TR^{\langle \mathrm{H}\rangle}_{t} + Y^{\langle \mathrm{H}\rangle}_{t} - \psi^{\langle \mathrm{H}\rangle} K^{\langle \mathrm{H}\rangle}_{t-1} \left(-\delta^{\langle \mathrm{H}\rangle} + {K^{\langle \mathrm{H}\rangle}_{t-1}}^{-1} I^{\langle \mathrm{H}\rangle}_{t}\right)^{2} = 0 \tag{6.23}$$

7 Steady state relationships (before expansion and reduction)

$$-\sum_{c \in \mathit{COUNTRY}} TR^{\langle c\rangle}_{\mathrm{ss}} = 0 \tag{7.1}$$

$$\lambda^{\mathrm{c}\,\langle \mathrm{F}\rangle}_{\mathrm{ss}} - \lambda^{\mathrm{c}\,\langle \mathrm{H}\rangle}_{\mathrm{ss}} = 0 \tag{7.2}$$

$$c \in \mathit{COUNTRY}: \quad -\lambda^{\mathrm{CONSUMER}^{2}\,\langle c\rangle}_{\mathrm{ss}} + \beta \left(\lambda^{\mathrm{CONSUMER}^{2}\,\langle c\rangle}_{\mathrm{ss}} \left(1 - \delta^{\langle c\rangle}\right) + \lambda^{\mathrm{c}\,\langle c\rangle}_{\mathrm{ss}} \left(r^{\langle c\rangle}_{\mathrm{ss}} - \psi^{\langle c\rangle} \left(-\delta^{\langle c\rangle} + I^{\langle c\rangle}_{\mathrm{ss}} {K^{\langle c\rangle}_{\mathrm{ss}}}^{-1}\right)^{2} + 2\psi^{\langle c\rangle} I^{\langle c\rangle}_{\mathrm{ss}} {K^{\langle c\rangle}_{\mathrm{ss}}}^{-1} \left(-\delta^{\langle c\rangle} + I^{\langle c\rangle}_{\mathrm{ss}} {K^{\langle c\rangle}_{\mathrm{ss}}}^{-1}\right)\right)\right) = 0 \tag{7.3}$$

$$c \in \mathit{COUNTRY}: \quad {\lambda^{\mathrm{CONSUMER}^2}}_{\mathrm{ss}}^{\langle c\rangle} + {\lambda^{\mathrm{c}}}_{\mathrm{ss}}^{\langle c\rangle}\left(-1 - 2\psi^{\langle c\rangle}\left(-\delta^{\langle c\rangle} + I_{\mathrm{ss}}^{\langle c\rangle}{K_{\mathrm{ss}}^{\langle c\rangle}}^{-1}\right)\right) = 0 \tag{7.4}$$

$$c \in \mathit{COUNTRY}: \quad -{\lambda^{\mathrm{c}}}_{\mathrm{ss}}^{\langle c\rangle} + \mu{C_{\mathrm{ss}}^{\langle c\rangle}}^{-1+\mu}\left(1 - H_{\mathrm{ss}}^{\langle c\rangle}\right)^{1-\mu}\left({C_{\mathrm{ss}}^{\langle c\rangle}}^{\mu}\left(1 - H_{\mathrm{ss}}^{\langle c\rangle}\right)^{1-\mu}\right)^{-\eta} = 0 \tag{7.5}$$

$$c \in \mathit{COUNTRY}: \quad -\pi_{\mathrm{ss}}^{\langle c\rangle} + \Pi_{\mathrm{ss}}^{\langle c\rangle} = 0 \tag{7.6}$$

$$c \in \mathit{COUNTRY}: \quad -r_{\mathrm{ss}}^{\langle c\rangle} + \alpha^{\langle c\rangle}Z_{\mathrm{ss}}^{\langle c\rangle}{{H^{\mathrm{d}}}_{\mathrm{ss}}^{\langle c\rangle}}^{1-\alpha^{\langle c\rangle}}{{K^{\mathrm{d}}}_{\mathrm{ss}}^{\langle c\rangle}}^{-1+\alpha^{\langle c\rangle}} = 0 \tag{7.7}$$

$$c \in \mathit{COUNTRY}: \quad {G^{\mathrm{d}}}_{\mathrm{ss}}^{\langle c\rangle} - T_{\mathrm{ss}}^{\langle c\rangle} = 0 \tag{7.8}$$

$$c \in \mathit{COUNTRY}: \quad H_{\mathrm{ss}}^{\langle c\rangle} - {H^{\mathrm{d}}}_{\mathrm{ss}}^{\langle c\rangle} = 0 \tag{7.9}$$

$$c \in \mathit{COUNTRY}: \quad K_{\mathrm{ss}}^{\langle c\rangle} - {K^{\mathrm{d}}}_{\mathrm{ss}}^{\langle c\rangle} = 0 \tag{7.10}$$

$$c \in \mathit{COUNTRY}: \quad -W_{\mathrm{ss}}^{\langle c\rangle} + Z_{\mathrm{ss}}^{\langle c\rangle}\left(1 - \alpha^{\langle c\rangle}\right){{H^{\mathrm{d}}}_{\mathrm{ss}}^{\langle c\rangle}}^{-\alpha^{\langle c\rangle}}{{K^{\mathrm{d}}}_{\mathrm{ss}}^{\langle c\rangle}}^{\alpha^{\langle c\rangle}} = 0 \tag{7.11}$$

$$c \in \mathit{COUNTRY}: \quad -Y_{\mathrm{ss}}^{\langle c\rangle} + Z_{\mathrm{ss}}^{\langle c\rangle}{{H^{\mathrm{d}}}_{\mathrm{ss}}^{\langle c\rangle}}^{1-\alpha^{\langle c\rangle}}{{K^{\mathrm{d}}}_{\mathrm{ss}}^{\langle c\rangle}}^{\alpha^{\langle c\rangle}} = 0 \tag{7.12}$$

$$c \in \mathit{COUNTRY}: \quad -Z_{\mathrm{ss}}^{\langle c\rangle} + e^{{\epsilon^{\mathrm{Z}}}_{\mathrm{ss}}^{\langle c\rangle} + \phi^{\mathrm{Z}\langle c\rangle}\log Z_{\mathrm{ss}}^{\langle c\rangle}} = 0 \tag{7.13}$$

$$c \in \mathit{COUNTRY}: \quad {\lambda^{\mathrm{c}}}_{\mathrm{ss}}^{\langle c\rangle}W_{\mathrm{ss}}^{\langle c\rangle} + (-1 + \mu)\,{C_{\mathrm{ss}}^{\langle c\rangle}}^{\mu}\left(1 - H_{\mathrm{ss}}^{\langle c\rangle}\right)^{-\mu}\left({C_{\mathrm{ss}}^{\langle c\rangle}}^{\mu}\left(1 - H_{\mathrm{ss}}^{\langle c\rangle}\right)^{1-\mu}\right)^{-\eta} = 0 \tag{7.14}$$

$$c \in \mathit{COUNTRY}: \quad {\epsilon^{\mathrm{G}}}_{\mathrm{ss}}^{\langle c\rangle} - {G^{\mathrm{d}}}_{\mathrm{ss}}^{\langle c\rangle} + \phi^{\mathrm{G}\langle c\rangle}{G^{\mathrm{d}}}_{\mathrm{ss}}^{\langle c\rangle} = 0 \tag{7.15}$$

$$c \in \mathit{COUNTRY}: \quad I_{\mathrm{ss}}^{\langle c\rangle} - K_{\mathrm{ss}}^{\langle c\rangle} + K_{\mathrm{ss}}^{\langle c\rangle}\left(1 - \delta^{\langle c\rangle}\right) = 0 \tag{7.16}$$

$$c \in \mathit{COUNTRY}: \quad U_{\mathrm{ss}}^{\langle c\rangle} - \beta U_{\mathrm{ss}}^{\langle c\rangle} - (1 - \eta)^{-1}\left({C_{\mathrm{ss}}^{\langle c\rangle}}^{\mu}\left(1 - H_{\mathrm{ss}}^{\langle c\rangle}\right)^{1-\mu}\right)^{1-\eta} = 0 \tag{7.17}$$

$$c \in \mathit{COUNTRY}: \quad -\pi_{\mathrm{ss}}^{\langle c\rangle} + Y_{\mathrm{ss}}^{\langle c\rangle} - r_{\mathrm{ss}}^{\langle c\rangle}{K^{\mathrm{d}}}_{\mathrm{ss}}^{\langle c\rangle} - {H^{\mathrm{d}}}_{\mathrm{ss}}^{\langle c\rangle}W_{\mathrm{ss}}^{\langle c\rangle} = 0 \tag{7.18}$$

$$c \in \mathit{COUNTRY}: \quad \pi_{\mathrm{ss}}^{\langle c\rangle} - C_{\mathrm{ss}}^{\langle c\rangle} - I_{\mathrm{ss}}^{\langle c\rangle} - T_{\mathrm{ss}}^{\langle c\rangle} + \mathit{TR}_{\mathrm{ss}}^{\langle c\rangle} + r_{\mathrm{ss}}^{\langle c\rangle}K_{\mathrm{ss}}^{\langle c\rangle} + H_{\mathrm{ss}}^{\langle c\rangle}W_{\mathrm{ss}}^{\langle c\rangle} - \psi^{\langle c\rangle}K_{\mathrm{ss}}^{\langle c\rangle}\left(-\delta^{\langle c\rangle} + I_{\mathrm{ss}}^{\langle c\rangle}{K_{\mathrm{ss}}^{\langle c\rangle}}^{-1}\right)^2 = 0 \tag{7.19}$$

8 Steady state relationships (after expansion and reduction)

$$-\lambda^{\mathrm{c}\langle \mathrm{F}\rangle}_{\mathrm{ss}} + \mu {C^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}}^{-1+\mu}\left(1-H^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}\right)^{1-\mu}\left({C^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}}^{\mu}\left(1-H^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}\right)^{1-\mu}\right)^{-\eta}=0 \tag{8.1}$$

$$\lambda^{\mathrm{c}\langle \mathrm{F}\rangle}_{\mathrm{ss}} - \lambda^{\mathrm{c}\langle \mathrm{H}\rangle}_{\mathrm{ss}} = 0 \tag{8.2}$$

$$-\lambda^{\mathrm{c}\langle \mathrm{H}\rangle}_{\mathrm{ss}} + \mu {C^{\langle \mathrm{H}\rangle}_{\mathrm{ss}}}^{-1+\mu}\left(1-H^{\langle \mathrm{H}\rangle}_{\mathrm{ss}}\right)^{1-\mu}\left({C^{\langle \mathrm{H}\rangle}_{\mathrm{ss}}}^{\mu}\left(1-H^{\langle \mathrm{H}\rangle}_{\mathrm{ss}}\right)^{1-\mu}\right)^{-\eta}=0 \tag{8.3}$$

$$-r^{\langle \mathrm{F}\rangle}_{\mathrm{ss}} + \alpha^{\langle \mathrm{F}\rangle} Z^{\langle \mathrm{F}\rangle}_{\mathrm{ss}} {H^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}}^{1-\alpha^{\langle \mathrm{F}\rangle}} {K^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}}^{-1+\alpha^{\langle \mathrm{F}\rangle}} = 0 \tag{8.4}$$

$$-r^{\langle \mathrm{H}\rangle}_{\mathrm{ss}} + \alpha^{\langle \mathrm{H}\rangle} Z^{\langle \mathrm{H}\rangle}_{\mathrm{ss}} {H^{\langle \mathrm{H}\rangle}_{\mathrm{ss}}}^{1-\alpha^{\langle \mathrm{H}\rangle}} {K^{\langle \mathrm{H}\rangle}_{\mathrm{ss}}}^{-1+\alpha^{\langle \mathrm{H}\rangle}} = 0 \tag{8.5}$$

$$-G^{\mathrm{d}\langle \mathrm{F}\rangle}_{\mathrm{ss}} + \phi^{\mathrm{G}\langle \mathrm{F}\rangle} G^{\mathrm{d}\langle \mathrm{F}\rangle}_{\mathrm{ss}} = 0 \tag{8.6}$$

$$-G^{\mathrm{d}\langle \mathrm{H}\rangle}_{\mathrm{ss}} + \phi^{\mathrm{G}\langle \mathrm{H}\rangle} G^{\mathrm{d}\langle \mathrm{H}\rangle}_{\mathrm{ss}} = 0 \tag{8.7}$$

∞

$$-W^{\langle \mathrm{F}\rangle}_{\mathrm{ss}} + Z^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}\left(1-\alpha^{\langle \mathrm{F}\rangle}\right) {H^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}}^{-\alpha^{\langle \mathrm{F}\rangle}} {K^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}}^{\alpha^{\langle \mathrm{F}\rangle}} = 0 \tag{8.8}$$

$$-W^{\langle \mathrm{H}\rangle}_{\mathrm{ss}} + Z^{\langle \mathrm{H}\rangle}_{\mathrm{ss}}\left(1-\alpha^{\langle \mathrm{H}\rangle}\right) {H^{\langle \mathrm{H}\rangle}_{\mathrm{ss}}}^{-\alpha^{\langle \mathrm{H}\rangle}} {K^{\langle \mathrm{H}\rangle}_{\mathrm{ss}}}^{\alpha^{\langle \mathrm{H}\rangle}} = 0 \tag{8.9}$$

$$-Y^{\langle \mathrm{F}\rangle}_{\mathrm{ss}} + Z^{\langle \mathrm{F}\rangle}_{\mathrm{ss}} {H^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}}^{1-\alpha^{\langle \mathrm{F}\rangle}} {K^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}}^{\alpha^{\langle \mathrm{F}\rangle}} = 0 \tag{8.10}$$

$$-Y^{\langle \mathrm{H}\rangle}_{\mathrm{ss}} + Z^{\langle \mathrm{H}\rangle}_{\mathrm{ss}} {H^{\langle \mathrm{H}\rangle}_{\mathrm{ss}}}^{1-\alpha^{\langle \mathrm{H}\rangle}} {K^{\langle \mathrm{H}\rangle}_{\mathrm{ss}}}^{\alpha^{\langle \mathrm{H}\rangle}} = 0 \tag{8.11}$$

$$-Z^{\langle \mathrm{F}\rangle}_{\mathrm{ss}} + e^{\phi^{\mathrm{Z}\langle \mathrm{F}\rangle}\log Z^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}} = 0 \tag{8.12}$$

$$-Z^{\langle \mathrm{H}\rangle}_{\mathrm{ss}} + e^{\phi^{\mathrm{Z}\langle \mathrm{H}\rangle}\log Z^{\langle \mathrm{H}\rangle}_{\mathrm{ss}}} = 0 \tag{8.13}$$

$$\beta \Biggl(\lambda^{\mathrm{c}\langle \mathrm{F}\rangle}_{\mathrm{ss}} \biggl(r^{\langle \mathrm{F}\rangle}_{\mathrm{ss}} - \psi^{\langle \mathrm{F}\rangle}\Bigl(-\delta^{\langle \mathrm{F}\rangle} + I^{\langle \mathrm{F}\rangle}_{\mathrm{ss}} {K^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}}^{-1}\Bigr)^{2} + 2\psi^{\langle \mathrm{F}\rangle} I^{\langle \mathrm{F}\rangle}_{\mathrm{ss}} {K^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}}^{-1}\Bigl(-\delta^{\langle \mathrm{F}\rangle} + I^{\langle \mathrm{F}\rangle}_{\mathrm{ss}} {K^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}}^{-1}\Bigr)\biggr) - \lambda^{\mathrm{c}\langle \mathrm{F}\rangle}_{\mathrm{ss}} \Bigl(-1 - 2\psi^{\langle \mathrm{F}\rangle}\Bigl(-\delta^{\langle \mathrm{F}\rangle} + I^{\langle \mathrm{F}\rangle}_{\mathrm{ss}} {K^{\langle \mathrm{F}\rangle}_{\mathrm{ss}}}^{-1}\Bigr)\Bigr)\Bigl(1-\delta^{\langle \mathrm{F}\rangle}\Bigr)\Biggr) + \lambda^{\mathrm{c}\langle \mathrm{F}\rangle}_{\mathrm{ss}} \Bigl(-1 - 2\psi^{\langle \mathrm{F}\rangle}\Bigl(-\delta^{\langle \mathrm{F}\rangle} + \tag{8.14}$$

$$\beta \Bigg(\lambda^{c\langle H\rangle}_{ss}\Bigg(r^{\langle H\rangle}_{ss} - \psi^{\langle H\rangle}\left(-\delta^{\langle H\rangle} + I^{\langle H\rangle}_{ss}{K^{\langle H\rangle}_{ss}}^{-1}\right)^{2} + 2\psi^{\langle H\rangle} I^{\langle H\rangle}_{ss}{K^{\langle H\rangle}_{ss}}^{-1}\left(-\delta^{\langle H\rangle} + I^{\langle H\rangle}_{ss}{K^{\langle H\rangle}_{ss}}^{-1}\right)\Bigg) - \lambda^{c\langle H\rangle}_{ss}\left(-1 - 2\psi^{\langle H\rangle}\left(-\delta^{\langle H\rangle} + I^{\langle H\rangle}_{ss}{K^{\langle H\rangle}_{ss}}^{-1}\right)\right)\left(1 - \delta^{\langle H\rangle}\right)\Bigg) + \lambda^{c\langle H\rangle}_{ss}\Big(-1 - 2\psi^{\langle H\rangle}\Big(-\delta^{\langle H} \tag{8.15}$$

$$\lambda^{c\langle F\rangle}_{ss} W^{\langle F\rangle}_{ss} + (-1+\mu)\, {C^{\langle F\rangle}_{ss}}^{\mu}\left(1 - H^{\langle F\rangle}_{ss}\right)^{-\mu}\left({C^{\langle F\rangle}_{ss}}^{\mu}\left(1 - H^{\langle F\rangle}_{ss}\right)^{1-\mu}\right)^{-\eta} = 0 \tag{8.16}$$

$$\lambda^{c\langle H\rangle}_{ss} W^{\langle H\rangle}_{ss} + (-1+\mu)\, {C^{\langle H\rangle}_{ss}}^{\mu}\left(1 - H^{\langle H\rangle}_{ss}\right)^{-\mu}\left({C^{\langle H\rangle}_{ss}}^{\mu}\left(1 - H^{\langle H\rangle}_{ss}\right)^{1-\mu}\right)^{-\eta} = 0 \tag{8.17}$$

$$I^{\langle F\rangle}_{ss} - K^{\langle F\rangle}_{ss} + K^{\langle F\rangle}_{ss}\left(1 - \delta^{\langle F\rangle}\right) = 0 \tag{8.18}$$

$$I^{\langle H\rangle}_{ss} - K^{\langle H\rangle}_{ss} + K^{\langle H\rangle}_{ss}\left(1 - \delta^{\langle H\rangle}\right) = 0 \tag{8.19}$$

$$U^{\langle F\rangle}_{ss} - \beta U^{\langle F\rangle}_{ss} - (1-\eta)^{-1}\left({C^{\langle F\rangle}_{ss}}^{\mu}\left(1 - H^{\langle F\rangle}_{ss}\right)^{1-\mu}\right)^{1-\eta} = 0 \tag{8.20}$$

$$U^{\langle H\rangle}_{ss} - \beta U^{\langle H\rangle}_{ss} - (1-\eta)^{-1}\left({C^{\langle H\rangle}_{ss}}^{\mu}\left(1 - H^{\langle H\rangle}_{ss}\right)^{1-\mu}\right)^{1-\eta} = 0 \tag{8.21}$$

$$-C^{\langle F\rangle}_{ss} - G^{d\langle F\rangle}_{ss} - I^{\langle F\rangle}_{ss} - TR^{\langle H\rangle}_{ss} + Y^{\langle F\rangle}_{ss} - \psi^{\langle F\rangle} K^{\langle F\rangle}_{ss}\left(-\delta^{\langle F\rangle} + I^{\langle F\rangle}_{ss}{K^{\langle F\rangle}_{ss}}^{-1}\right)^{2} = 0 \tag{8.22}$$

$$-C^{\langle H\rangle}_{ss} - G^{d\langle H\rangle}_{ss} - I^{\langle H\rangle}_{ss} + TR^{\langle H\rangle}_{ss} + Y^{\langle H\rangle}_{ss} - \psi^{\langle H\rangle} K^{\langle H\rangle}_{ss}\left(-\delta^{\langle H\rangle} + I^{\langle H\rangle}_{ss}{K^{\langle H\rangle}_{ss}}^{-1}\right)^{2} = 0 \tag{8.23}$$

9 Steady-state values

	Steady-state value
$\lambda^{\mathrm{c}\langle \mathrm{F} \rangle}$	0.3934
$\lambda^{\mathrm{c}\langle \mathrm{H} \rangle}$	0.3934
$r^{\langle \mathrm{F} \rangle}$	0.0351
$r^{\langle \mathrm{H} \rangle}$	0.0351
$C^{\langle \mathrm{F} \rangle}$	0.9578
$C^{\langle \mathrm{H} \rangle}$	0.9578
$G^{\mathrm{d}\langle \mathrm{F} \rangle}$	0
$G^{\mathrm{d}\langle \mathrm{H} \rangle}$	0
$H^{\langle \mathrm{F} \rangle}$	0.2645
$H^{\langle \mathrm{H} \rangle}$	0.2645
$I^{\langle \mathrm{F} \rangle}$	0.3816
$I^{\langle \mathrm{H} \rangle}$	0.3816
$K^{\langle \mathrm{F} \rangle}$	15.2627
$K^{\langle \mathrm{H} \rangle}$	15.2627
$TR^{\langle \mathrm{H} \rangle}$	0
$U^{\langle \mathrm{F} \rangle}$	-125.6048
$U^{\langle \mathrm{H} \rangle}$	-125.6048
$W^{\langle \mathrm{F} \rangle}$	3.0384
$W^{\langle \mathrm{H} \rangle}$	3.0384
$Y^{\langle \mathrm{F} \rangle}$	1.3393
$Y^{\langle \mathrm{H} \rangle}$	1.3393
$Z^{\langle \mathrm{F} \rangle}$	1
$Z^{\langle \mathrm{H} \rangle}$	1

10 The solution of the 1st order perturbation

Matrix P

$$
\begin{array}{c}
\\
G^{\mathrm{d}\langle \mathrm{F} \rangle}_t \\
G^{\mathrm{d}\langle \mathrm{H} \rangle}_t \\
K^{\langle \mathrm{F} \rangle}_t \\
K^{\langle \mathrm{H} \rangle}_t \\
Z^{\langle \mathrm{F} \rangle}_t \\
Z^{\langle \mathrm{H} \rangle}_t
\end{array}
\begin{array}{c}
\begin{array}{cccccc}
G^{\mathrm{d}\langle \mathrm{F} \rangle}_{t-1} & G^{\mathrm{d}\langle \mathrm{H} \rangle}_{t-1} & K^{\langle \mathrm{F} \rangle}_{t-1} & K^{\langle \mathrm{H} \rangle}_{t-1} & Z^{\langle \mathrm{F} \rangle}_{t-1} & Z^{\langle \mathrm{H} \rangle}_{t-1}
\end{array} \\
\begin{pmatrix}
0.95 & 0 & 0 & 0 & 0 & 0 \\
0 & 0.95 & 0 & 0 & 0 & 0 \\
-0.1542 & -0.1542 & 0.9454 & 0.0244 & 2.2856 & -1.0704 \\
-0.1542 & -0.1542 & 0.0244 & 0.9454 & -1.0704 & 2.2856 \\
0 & 0 & 0 & 0 & 0.95 & 0 \\
0 & 0 & 0 & 0 & 0 & 0.95
\end{pmatrix}
\end{array}
$$

Matrix Q

$$
\begin{array}{c}
\\
G^{\mathrm{d}\langle \mathrm{F} \rangle} \\
G^{\mathrm{d}\langle \mathrm{H} \rangle} \\
K^{\langle \mathrm{F} \rangle} \\
K^{\langle \mathrm{H} \rangle} \\
Z^{\langle \mathrm{F} \rangle} \\
Z^{\langle \mathrm{H} \rangle}
\end{array}
\begin{array}{c}
\begin{array}{cccc}
\epsilon^{\mathrm{Z}\langle \mathrm{F} \rangle} & \epsilon^{\mathrm{Z}\langle \mathrm{H} \rangle} & \epsilon^{\mathrm{G}\langle \mathrm{F} \rangle} & \epsilon^{\mathrm{G}\langle \mathrm{H} \rangle}
\end{array} \\
\begin{pmatrix}
0 & 0 & 1 & 0 \\
0 & 0 & 0 & 1 \\
2.4059 & -1.1267 & -0.1623 & -0.1623 \\
-1.1267 & 2.4059 & -0.1623 & -0.1623 \\
1 & 0 & 0 & 0 \\
0 & 1 & 0 & 0
\end{pmatrix}
\end{array}
$$

Matrix R

$$\begin{array}{cc}
 & \begin{array}{cccccc} G^{\mathrm{d}\langle\mathrm{F}\rangle}_{t-1} & G^{\mathrm{d}\langle\mathrm{H}\rangle}_{t-1} & K^{\langle\mathrm{F}\rangle}_{t-1} & K^{\langle\mathrm{H}\rangle}_{t-1} & Z^{\langle\mathrm{F}\rangle}_{t-1} & Z^{\langle\mathrm{H}\rangle}_{t-1} \end{array} \\
\begin{array}{c}
\lambda^{\mathrm{c}\langle\mathrm{F}\rangle}_t \\
\lambda^{\mathrm{c}\langle\mathrm{H}\rangle}_t \\
r^{\langle\mathrm{F}\rangle}_t \\
r^{\langle\mathrm{H}\rangle}_t \\
C^{\langle\mathrm{F}\rangle}_t \\
C^{\langle\mathrm{H}\rangle}_t \\
H^{\langle\mathrm{F}\rangle}_t \\
H^{\langle\mathrm{H}\rangle}_t \\
I^{\langle\mathrm{F}\rangle}_t \\
I^{\langle\mathrm{H}\rangle}_t \\
TR^{\langle\mathrm{H}\rangle}_t \\
U^{\langle\mathrm{F}\rangle}_t \\
U^{\langle\mathrm{H}\rangle}_t \\
W^{\langle\mathrm{F}\rangle}_t \\
W^{\langle\mathrm{H}\rangle}_t \\
Y^{\langle\mathrm{F}\rangle}_t \\
Y^{\langle\mathrm{H}\rangle}_t
\end{array} &
\begin{pmatrix}
0.1022 & 0.1022 & -0.0091 & -0.0091 & -0.1072 & -0.1072 \\
0.1022 & 0.1022 & -0.0091 & -0.0091 & -0.1072 & -0.1072 \\
0.0044 & 0.0044 & -0.0012 & -0.0004 & 0.0497 & -0.0046 \\
0.0044 & 0.0044 & -0.0004 & -0.0012 & -0.0046 & 0.0497 \\
-0.1525 & -0.1525 & 0.0187 & 0.0136 & 0.3448 & 0.1599 \\
-0.1525 & -0.1525 & 0.0136 & 0.0187 & 0.1599 & 0.3448 \\
0.0554 & 0.0554 & 0.0023 & -0.0049 & 0.2054 & -0.0581 \\
0.0554 & 0.0554 & -0.0049 & 0.0023 & -0.0581 & 0.2054 \\
-0.1542 & -0.1542 & -0.0296 & 0.0244 & 2.2856 & -1.0704 \\
-0.1542 & -0.1542 & 0.0244 & -0.0296 & -1.0704 & 2.2856 \\
-0.475 & 0.475 & 0.053 & -0.053 & -0.7338 & 0.7338 \\
-3.1408 & -3.1408 & 0.1608 & 0.2366 & 0.053 & 8.3603 \\
-3.1408 & -3.1408 & 0.2366 & 0.1608 & 8.3603 & 0.053 \\
-0.2547 & -0.2547 & 0.0689 & 0.0227 & 1.9424 & 0.2672 \\
-0.2547 & -0.2547 & 0.0227 & 0.0689 & 0.2672 & 1.9424 \\
0.1684 & 0.1684 & 0.0422 & -0.015 & 1.8966 & -0.1767 \\
0.1684 & 0.1684 & -0.015 & 0.0422 & -0.1767 & 1.8966
\end{pmatrix}
\end{array}$$

Matrix S

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

11 Model statistics

11.1 Basic statistics

	Steady-state value	Std. dev.	Variance	Loglin
$r^{\langle \mathrm{H} \rangle}$	0.0351	0.0051	0	N
$C^{\langle \mathrm{H} \rangle}$	0.9578	0.034	0.0012	N
$G^{\mathrm{d}\,\langle \mathrm{H} \rangle}$	0	0.0922	0.0085	N
$H^{\langle \mathrm{H} \rangle}$	0.2645	0.0249	0.0006	N
$I^{\langle \mathrm{H} \rangle}$	0.3816	0.2411	0.0581	N
$K^{\langle \mathrm{H} \rangle}$	15.2627	0.8242	0.6794	N
$TR^{\langle \mathrm{H} \rangle}$	0	0.1586	0.0252	N
$U^{\langle \mathrm{H} \rangle}$	-125.6048	0.7839	0.6144	N
$W^{\langle \mathrm{H} \rangle}$	3.0384	0.1864	0.0348	N
$Y^{\langle \mathrm{H} \rangle}$	1.3393	0.2022	0.0409	N
$Z^{\langle \mathrm{H} \rangle}$	1	0.0922	0.0085	N

11.2 Correlation matrix

	$r^{\langle \mathrm{H} \rangle}$	$C^{\langle \mathrm{H} \rangle}$	$G^{\mathrm{d}\,\langle \mathrm{H} \rangle}$	$H^{\langle \mathrm{H} \rangle}$	$I^{\langle \mathrm{H} \rangle}$	$K^{\langle \mathrm{H} \rangle}$	$TR^{\langle \mathrm{H} \rangle}$	$U^{\langle \mathrm{H} \rangle}$	$W^{\langle \mathrm{H} \rangle}$	$Y^{\langle \mathrm{H} \rangle}$	$Z^{\langle \mathrm{H} \rangle}$
$r^{\langle \mathrm{H} \rangle}$	1	0.659	0.554	0.918	0.888	0.193	0.623	-0.274	0.889	0.934	0.983
$C^{\langle \mathrm{H} \rangle}$		1	0.06	0.562	0.592	0.393	0.241	0.314	0.889	0.712	0.769
$G^{\mathrm{d}\,\langle \mathrm{H} \rangle}$			1	0.625	0.391	0.151	0.493	-0.39	0.38	0.545	0.5
$H^{\langle \mathrm{H} \rangle}$				1	0.813	0.512	0.469	-0.445	0.878	0.981	0.927
$I^{\langle \mathrm{H} \rangle}$					1	0.231	0.817	-0.501	0.792	0.829	0.874
$K^{\langle \mathrm{H} \rangle}$						1	-0.15	-0.259	0.511	0.527	0.325
$TR^{\langle \mathrm{H} \rangle}$							1	-0.534	0.398	0.454	0.55
$U^{\langle \mathrm{H} \rangle}$								1	-0.064	-0.303	-0.197
$W^{\langle \mathrm{H} \rangle}$									1	0.954	0.958
$Y^{\langle \mathrm{H} \rangle}$										1	0.968
$Z^{\langle \mathrm{H} \rangle}$											1

11.3 Cross correlations with the reference variable ($Y^{\langle \mathrm{H} \rangle}$)

	$\sigma[\cdot]$ rel. to $\sigma[Y^{\langle \mathrm{H} \rangle}]$	$Y^{\langle \mathrm{H} \rangle}_{t-4}$	$Y^{\langle \mathrm{H} \rangle}_{t-3}$	$Y^{\langle \mathrm{H} \rangle}_{t-2}$	$Y^{\langle \mathrm{H} \rangle}_{t-1}$	$Y^{\langle \mathrm{H} \rangle}_{t}$	$Y^{\langle \mathrm{H} \rangle}_{t+1}$	$Y^{\langle \mathrm{H} \rangle}_{t+2}$	$Y^{\langle \mathrm{H} \rangle}_{t+3}$	$Y^{\langle \mathrm{H} \rangle}_{t+4}$
$r^{\langle \mathrm{H} \rangle}_t$	0.025	0.28	0.415	0.57	0.744	0.934	0.583	0.301	0.081	-0.085
$C^{\langle \mathrm{H} \rangle}_t$	0.168	0.053	0.174	0.324	0.503	0.712	0.562	0.425	0.301	0.192
$G^{\mathrm{d}\,\langle \mathrm{H} \rangle}_t$	0.456	0.118	0.202	0.301	0.415	0.545	0.373	0.229	0.113	0.021
$H^{\langle \mathrm{H} \rangle}_t$	0.123	0.187	0.344	0.529	0.741	0.981	0.725	0.501	0.309	0.148
$I^{\langle \mathrm{H} \rangle}_t$	1.192	0.283	0.401	0.532	0.676	0.829	0.5	0.239	0.037	-0.113
$K^{\langle \mathrm{H} \rangle}_t$	4.076	-0.182	-0.06	0.097	0.292	0.527	0.661	0.714	0.707	0.656
$TR^{\langle \mathrm{H} \rangle}_t$	0.785	0.293	0.339	0.384	0.423	0.454	0.145	-0.081	-0.237	-0.336
$U^{\langle \mathrm{H} \rangle}_t$	3.876	-0.155	-0.196	-0.236	-0.273	-0.303	-0.189	-0.095	-0.021	0.037
$W^{\langle \mathrm{H} \rangle}_t$	0.922	0.134	0.291	0.479	0.701	0.954	0.726	0.522	0.345	0.193
$Y^{\langle \mathrm{H} \rangle}_t$	1	0.171	0.333	0.525	0.748	1	0.748	0.525	0.333	0.171
$Z^{\langle \mathrm{H} \rangle}_t$	0.456	0.229	0.377	0.549	0.747	0.968	0.656	0.398	0.188	0.024

11.4 Autocorrelations

	Lag 1	Lag 2	Lag 3	Lag 4
$r^{\langle \mathrm{H} \rangle}$	0.704	0.456	0.254	0.093
$C^{\langle \mathrm{H} \rangle}$	0.75	0.529	0.338	0.177
$G^{\mathrm{d}\,\langle \mathrm{H} \rangle}$	0.713	0.471	0.271	0.11
$H^{\langle \mathrm{H} \rangle}$	0.748	0.525	0.333	0.171
$I^{\langle \mathrm{H} \rangle}$	0.698	0.447	0.244	0.083
$K^{\langle \mathrm{H} \rangle}$	0.956	0.852	0.709	0.546
$TR^{\langle \mathrm{H} \rangle}$	0.72	0.482	0.283	0.122
$U^{\langle \mathrm{H} \rangle}$	0.731	0.499	0.303	0.142
$W^{\langle \mathrm{H} \rangle}$	0.748	0.526	0.334	0.173
$Y^{\langle \mathrm{H} \rangle}$	0.748	0.525	0.333	0.171
$Z^{\langle \mathrm{H} \rangle}$	0.713	0.471	0.271	0.11

11.5 Variance decomposition

	$\epsilon^{\mathrm{Z}\,\langle \mathrm{F} \rangle}$	$\epsilon^{\mathrm{Z}\,\langle \mathrm{H} \rangle}$	$\epsilon^{\mathrm{G}\,\langle \mathrm{F} \rangle}$	$\epsilon^{\mathrm{G}\,\langle \mathrm{H} \rangle}$
$r^{\langle \mathrm{H} \rangle}$	0.002	0.987	0.005	0.005
$C^{\langle \mathrm{H} \rangle}$	0.059	0.657	0.142	0.142
$G^{\mathrm{d}\,\langle \mathrm{H} \rangle}$	0	0.25	0	0.75
$H^{\langle \mathrm{H} \rangle}$	0.051	0.88	0.035	0.035
$I^{\langle \mathrm{H} \rangle}$	0.214	0.78	0.003	0.003
$K^{\langle \mathrm{H} \rangle}$	0.208	0.785	0.003	0.003
$TR^{\langle \mathrm{H} \rangle}$	0.437	0.437	0.063	0.063
$U^{\langle \mathrm{H} \rangle}$	0.733	0.041	0.113	0.113
$W^{\langle \mathrm{H} \rangle}$	0.005	0.968	0.014	0.014
$Y^{\langle \mathrm{H} \rangle}$	0.021	0.969	0.005	0.005
$Z^{\langle \mathrm{H} \rangle}$	0	1	0	0

12 Impulse response functions

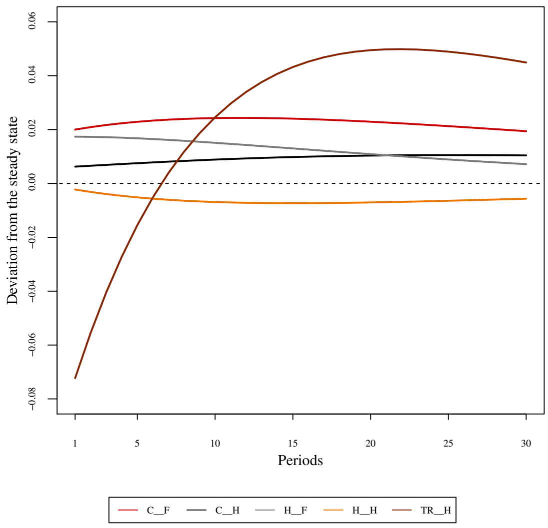

Figure 1: Impulse responses $(C^{\langle \mathrm{F}\rangle}, C^{\langle \mathrm{H}\rangle}, H^{\langle \mathrm{F}\rangle}, H^{\langle \mathrm{H}\rangle}, TR^{\langle \mathrm{H}\rangle})$ to $\epsilon^{\mathrm{Z}\langle \mathrm{F}\rangle}$ shock

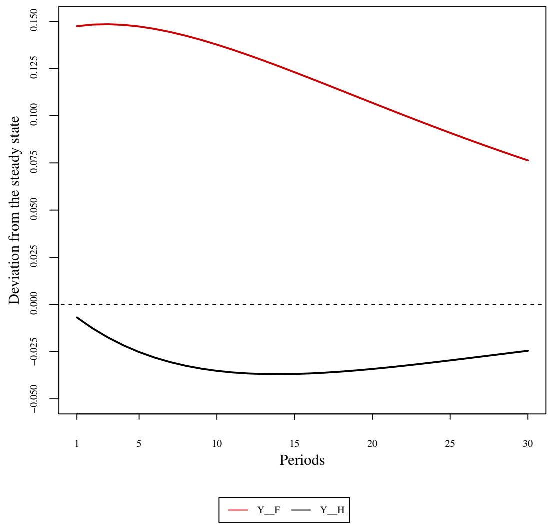

Figure 2: Impulse responses $(Y^{\langle \mathrm{F}\rangle}, Y^{\langle \mathrm{H}\rangle})$ to $\epsilon^{\mathrm{Z}\langle \mathrm{F}\rangle}$ shock

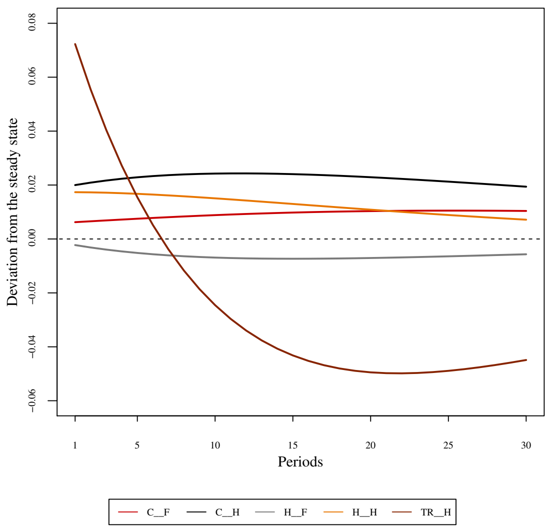

Figure 3: Impulse responses $(C^{\langle \mathrm{F}\rangle}, C^{\langle \mathrm{H}\rangle}, H^{\langle \mathrm{F}\rangle}, H^{\langle \mathrm{H}\rangle}, TR^{\langle \mathrm{H}\rangle})$ to $\epsilon^{\mathrm{Z}\langle \mathrm{H}\rangle}$ shock

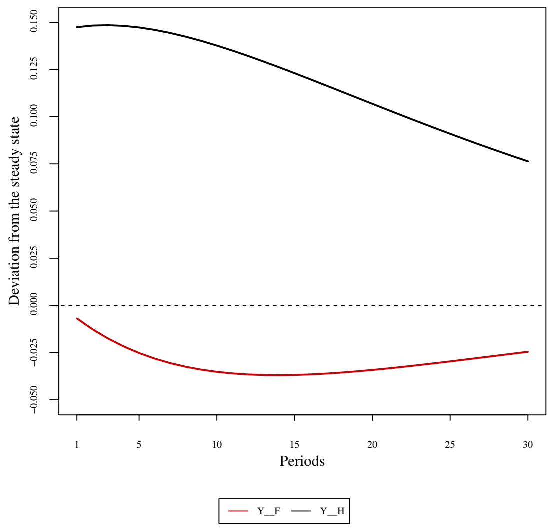

Figure 4: Impulse responses $(Y^{\langle \mathrm{F}\rangle}, Y^{\langle \mathrm{H}\rangle})$ to $\epsilon^{\mathrm{Z}\langle \mathrm{H}\rangle}$ shock