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1 CONSUMER

1.1 Optimisation problem

$$\max_{C_t, N_t, a_t, L_t} U_t = \beta \mathrm{E}_t \left[U_{t+1} \right] + \gamma^{-1} \left({C_t}^{\mu} {L_t}^{1-\mu} \right)^{\gamma} \tag{1.1}$$

s.t. :

$$C_t = \pi_t + N_t W_t \quad (\lambda_t^{\mathrm{c}}) \tag{1.2}$$

$$L_t = 1 - \alpha N_t - \eta a_{t-1} \left(1 - \alpha \right) \quad \left(\lambda_t^{\mathrm{CONSUMER}^2} \right) \tag{1.3}$$

$$a_t = N_t + a_{t-1} \left(1 - \eta \right) \quad \left(\lambda_t^{\mathrm{CONSUMER}^3} \right) \tag{1.4}$$

1.2 First order conditions

$$\beta - \lambda_t^{\mathrm{U}} = 0 \quad (U_t) \tag{1.5}$$

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

$$\lambda_t^{\mathrm{CONSUMER}^3} + \lambda_t^{\mathrm{c}} W_t - \alpha \lambda_t^{\mathrm{CONSUMER}^2} = 0 \quad (N_t) \tag{1.7}$$

$$-\lambda_t^{\mathrm{CONSUMER}^3} + \mathrm{E}_t \left[\lambda_{t+1}^{\mathrm{U}} \left(\lambda_{t+1}^{\mathrm{CONSUMER}^3} \left(1 - \eta \right) - \eta \lambda_{t+1}^{\mathrm{CONSUMER}^2} \left(1 - \alpha \right) \right) \right] = 0 \quad (a_t) \tag{1.8}$$

$$-\lambda_t^{\mathrm{CONSUMER}^2} + \left(1 - \mu \right) {C_t}^{\mu} {L_t}^{-\mu} \left({C_t}^{\mu} {L_t}^{1-\mu} \right)^{-1+\gamma} = 0 \quad (L_t) \tag{1.9}$$

2 FIRM

2.1 Optimisation problem

$$\max_{K_t,N_t^{\mathrm{d}},Z_t,Y_t,S_t,X_t,\pi_t,S_t^{\mathrm{lag}^1},S_t^{\mathrm{lag}^2}} \Pi_t = \pi_t + {\lambda_t^{\mathrm{c}}}^{-1}\mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{c}}\lambda_{t+1}^{\mathrm{U}}\Pi_{t+1}\right] \tag{2.1}$$

s.t. :

$$Y_t = \left(\sigma {Z_{t-1}}^{-\nu} + \left(\Lambda_t {K_{t-1}}^{\theta} {N_t^{\mathrm{d}}}^{1-\theta}\right)^{-\nu}\right)^{-\nu^{-1}} \quad \left(\lambda_t^{\mathrm{FIRM}^1}\right) \tag{2.2}$$

$$K_t = S_{t-3} + K_{t-1}\left(1-\delta\right) \quad \left(\lambda_t^{\mathrm{FIRM}^2}\right) \tag{2.3}$$

$$X_t = \psi\left(S_{t-3} + S_{t-2} + S_{t-1} + S_t\right) \quad \left(\lambda_t^{\mathrm{FIRM}^3}\right) \tag{2.4}$$

$$\pi_t = Z_{t-1} - X_t + Y_t - Z_t - N_t^{\mathrm{d}} W_t \quad \left(\lambda_t^{\mathrm{FIRM}^4}\right) \tag{2.5}$$

2.2 First order conditions

$$-\lambda_t^{\mathrm{FIRM}^{\Pi}} + {\lambda_{t-1}^{\mathrm{c}}}^{-1}\lambda_t^{\mathrm{c}}\lambda_t^{\mathrm{U}} = 0 \quad (\Pi_t) \tag{2.6}$$

$$-\lambda_t^{\mathrm{FIRM}^2} + \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{FIRM}^{\Pi}}\left(\lambda_{t+1}^{\mathrm{FIRM}^2}\left(1-\delta\right) + \theta\lambda_{t+1}^{\mathrm{FIRM}^1}\Lambda_{t+1}{K_t}^{-1+\theta}{N_{t+1}^{\mathrm{d}}}^{1-\theta}\left(\sigma {Z_t}^{-\nu} + \left(\Lambda_{t+1}{K_t}^{\theta}{N_{t+1}^{\mathrm{d}}}^{1-\theta}\right)^{-\nu}\right)^{-1-\nu^{-1}}\left(\Lambda_{t+1}{K_t}^{\theta}{N_{t+1}^{\mathrm{d}}}^{1-\theta}\right)^{-1-\nu}\right)\right] = 0 \quad (K_t) \tag{2.7}$$

$$-\lambda_t^{\mathrm{FIRM}^4} W_t + \lambda_t^{\mathrm{FIRM}^1}\Lambda_t\left(1-\theta\right){K_{t-1}}^{\theta}{N_t^{\mathrm{d}}}^{-\theta}\left(\sigma {Z_{t-1}}^{-\nu} + \left(\Lambda_t {K_{t-1}}^{\theta}{N_t^{\mathrm{d}}}^{1-\theta}\right)^{-\nu}\right)^{-1-\nu^{-1}}\left(\Lambda_t {K_{t-1}}^{\theta}{N_t^{\mathrm{d}}}^{1-\theta}\right)^{-1-\nu} = 0 \quad \left(N_t^{\mathrm{d}}\right) \tag{2.8}$$

$$-\lambda_t^{\mathrm{FIRM}^4} + \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{FIRM}^{\Pi}}\left(\lambda_{t+1}^{\mathrm{FIRM}^4} + \sigma\lambda_{t+1}^{\mathrm{FIRM}^1}{Z_t}^{-1-\nu}\left(\sigma {Z_t}^{-\nu} + \left(\Lambda_{t+1}{K_t}^{\theta}{N_{t+1}^{\mathrm{d}}}^{1-\theta}\right)^{-\nu}\right)^{-1-\nu^{-1}}\right)\right] = 0 \quad (Z_t) \tag{2.9}$$

$$-\lambda_t^{\mathrm{FIRM}^1} + \lambda_t^{\mathrm{FIRM}^4} = 0 \quad (Y_t) \tag{2.10}$$

$$\psi\lambda_t^{\mathrm{FIRM}^3} + \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{FIRM}^{\Pi}}\left(\lambda_{t+1}^{\mathrm{FIRM}^{S^{\mathrm{lag}^1}}} + \psi\lambda_{t+1}^{\mathrm{FIRM}^3}\right)\right] = 0 \quad (S_t) \tag{2.11}$$

$$-\lambda_t^{\mathrm{FIRM}^3} - \lambda_t^{\mathrm{FIRM}^4} = 0 \quad (X_t) \tag{2.12}$$

$$1 - \lambda_t^{\mathrm{FIRM}^4} = 0 \quad (\pi_t) \tag{2.13}$$

$$-\lambda_t^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^1}}} + \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{FIRM}^{\Pi}}\left(\lambda_{t+1}^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^2}}} + \psi\lambda_{t+1}^{\mathrm{FIRM}^3}\right)\right] = 0 \quad \left(S_t^{\mathrm{lag}^1}\right) \tag{2.14}$$

$$-\lambda_t^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^2}}} + \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{FIRM}^{\Pi}}\left(\lambda_{t+1}^{\mathrm{FIRM}^2} + \psi\lambda_{t+1}^{\mathrm{FIRM}^3}\right)\right] = 0 \quad \left(S_t^{\mathrm{lag}^2}\right) \tag{2.15}$$

2.3 First order conditions after reduction

$$-\lambda_t^{\mathrm{FIRM}^{\Pi}} + {\lambda_{t-1}^{\mathrm{c}}}^{-1}\lambda_t^{\mathrm{c}}\lambda_t^{\mathrm{U}} = 0 \quad (\Pi_t) \tag{2.16}$$

$$-\lambda_t^{\mathrm{FIRM}^2} + \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{FIRM}^{\Pi}}\left(\lambda_{t+1}^{\mathrm{FIRM}^2}(1-\delta) + \theta\Lambda_{t+1}{K_t}^{-1+\theta}{N_{t+1}^{\mathrm{d}}}^{1-\theta}\left(\sigma{Z_t}^{-\nu} + \left(\Lambda_{t+1}{K_t}^{\theta}{N_{t+1}^{\mathrm{d}}}^{1-\theta}\right)^{-\nu}\right)^{-1-\nu^{-1}}\left(\Lambda_{t+1}{K_t}^{\theta}{N_{t+1}^{\mathrm{d}}}^{1-\theta}\right)^{-1-\nu}\right)\right] = 0 \quad (K_t) \tag{2.17}$$

$$-W_t + \Lambda_t(1-\theta){K_{t-1}}^{\theta}{N_t^{\mathrm{d}}}^{-\theta}\left(\sigma{Z_{t-1}}^{-\nu} + \left(\Lambda_t{K_{t-1}}^{\theta}{N_t^{\mathrm{d}}}^{1-\theta}\right)^{-\nu}\right)^{-1-\nu^{-1}}\left(\Lambda_t{K_{t-1}}^{\theta}{N_t^{\mathrm{d}}}^{1-\theta}\right)^{-1-\nu} = 0 \quad \left(N_t^{\mathrm{d}}\right) \tag{2.18}$$

$$-1 + \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{FIRM}^{\Pi}}\left(1 + \sigma{Z_t}^{-1-\nu}\left(\sigma{Z_t}^{-\nu} + \left(\Lambda_{t+1}{K_t}^{\theta}{N_{t+1}^{\mathrm{d}}}^{1-\theta}\right)^{-\nu}\right)^{-1-\nu^{-1}}\right)\right] = 0 \quad (Z_t) \tag{2.19}$$

$$-\psi + \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{FIRM}^{\Pi}}\left(-\psi + \lambda_{t+1}^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^1}}}\right)\right] = 0 \quad (S_t) \tag{2.20}$$

$$-\lambda_t^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^1}}} + \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{FIRM}^{\Pi}}\left(-\psi + \lambda_{t+1}^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^2}}}\right)\right] = 0 \quad \left(S_t^{\mathrm{lag}^1}\right) \tag{2.21}$$

$$-\lambda_t^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^2}}} + \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{FIRM}^{\Pi}}\left(-\psi + \lambda_{t+1}^{\mathrm{FIRM}^2}\right)\right] = 0 \quad \left(S_t^{\mathrm{lag}^2}\right) \tag{2.22}$$

3 EQUILIBRIUM

3.1 Identities

$$N_t^{\mathrm{d}} = N_t \tag{3.1}$$

4 EXOG

4.1 Identities

$$-1 + \Lambda_t = \epsilon_t^{\Lambda} + \phi^{\mathrm{a}}(-1 + \Lambda_{t-1}) + \phi^{\mathrm{b}}(-1 + \Lambda_{t-1}) \tag{4.1}$$

5 Equilibrium relationships (after reduction)

$$-1+\beta {C_t}^{1-\mu} {L_t}^{-1+\mu} \left({C_t}^{\mu} {L_t}^{1-\mu}\right)^{1-\gamma} \mathrm{E}_t\left[\left(1+\sigma {Z_t}^{-1-\nu}\left(\sigma {Z_t}^{-\nu}+\left(\Lambda_{t+1} {K_t}^{\theta} {N_{t+1}}^{1-\theta}\right)^{-\nu}\right)^{-1-\nu^{-1}}\right) {C_{t+1}}^{-1+\mu} {L_{t+1}}^{1-\mu}\left({C_{t+1}}^{\mu} {L_{t+1}}^{1-\mu}\right)^{-1+\gamma}\right]=0 \tag{5.1}$$

$$-\psi+\beta {C_t}^{1-\mu} {L_t}^{-1+\mu} \left({C_t}^{\mu} {L_t}^{1-\mu}\right)^{1-\gamma} \mathrm{E}_t\left[\left(-\psi+\lambda_{t+1}^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^1}}}\right) {C_{t+1}}^{-1+\mu} {L_{t+1}}^{1-\mu}\left({C_{t+1}}^{\mu} {L_{t+1}}^{1-\mu}\right)^{-1+\gamma}\right]=0 \tag{5.2}$$

$$S_{t-1}-S_t^{\mathrm{lag}^1}=0 \tag{5.3}$$

$$S_{t-1}^{\mathrm{lag}^1}-S_t^{\mathrm{lag}^2}=0 \tag{5.4}$$

$$-\lambda_t^{\mathrm{FIRM}^2}+\beta {C_t}^{1-\mu} {L_t}^{-1+\mu} \left({C_t}^{\mu} {L_t}^{1-\mu}\right)^{1-\gamma} \mathrm{E}_t\left[\left(\lambda_{t+1}^{\mathrm{FIRM}^2}(1-\delta)+\theta \Lambda_{t+1} {K_t}^{-1+\theta} {N_{t+1}}^{1-\theta}\left(\sigma {Z_t}^{-\nu}+\left(\Lambda_{t+1} {K_t}^{\theta} {N_{t+1}}^{1-\theta}\right)^{-\nu}\right)^{-1-\nu^{-1}}\left(\Lambda_{t+1} {K_t}^{\theta} {N_{t+1}}^{1-\theta}\right)^{-1-\nu}\right) {C_{t+1}}^{-1+\mu} {L_{t+1}}^{1-\mu}\left({C_{t+1}}\right. \tag{5.5}$$

$$-\lambda_t^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^1}}}+\beta {C_t}^{1-\mu} {L_t}^{-1+\mu} \left({C_t}^{\mu} {L_t}^{1-\mu}\right)^{1-\gamma} \mathrm{E}_t\left[\left(-\psi+\lambda_{t+1}^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^2}}}\right) {C_{t+1}}^{-1+\mu} {L_{t+1}}^{1-\mu}\left({C_{t+1}}^{\mu} {L_{t+1}}^{1-\mu}\right)^{-1+\gamma}\right]=0 \tag{5.6}$$

$$-\lambda_t^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^2}}}+\beta {C_t}^{1-\mu} {L_t}^{-1+\mu} \left({C_t}^{\mu} {L_t}^{1-\mu}\right)^{1-\gamma} \mathrm{E}_t\left[\left(-\psi+\lambda_{t+1}^{\mathrm{FIRM}^2}\right) {C_{t+1}}^{-1+\mu} {L_{t+1}}^{1-\mu}\left({C_{t+1}}^{\mu} {L_{t+1}}^{1-\mu}\right)^{-1+\gamma}\right]=0 \tag{5.7}$$

$$-W_t+\Lambda_t(1-\theta) {K_{t-1}}^{\theta} {N_t}^{-\theta}\left(\sigma {Z_{t-1}}^{-\nu}+\left(\Lambda_t {K_{t-1}}^{\theta} {N_t}^{1-\theta}\right)^{-\nu}\right)^{-1-\nu^{-1}}\left(\Lambda_t {K_{t-1}}^{\theta} {N_t}^{1-\theta}\right)^{-1-\nu}=0 \tag{5.8}$$

$$-Y_t+\left(\sigma {Z_{t-1}}^{-\nu}+\left(\Lambda_t {K_{t-1}}^{\theta} {N_t}^{1-\theta}\right)^{-\nu}\right)^{-\nu^{-1}}=0 \tag{5.9}$$

$$S_{t-1}^{\mathrm{lag}^2}-K_t+K_{t-1}(1-\delta)=0 \tag{5.10}$$

$$-a_t+N_t+a_{t-1}(1-\eta)=0 \tag{5.11}$$

$$-\pi_t+\Pi_t-\beta\left({C_t}^{-1+\mu}\right)^{-1}\left({L_t}^{1-\mu}\right)^{-1}\left(\left({C_t}^{\mu} {L_t}^{1-\mu}\right)^{-1+\gamma}\right)^{-1} \mathrm{E}_t\left[\Pi_{t+1} {C_{t+1}}^{-1+\mu} {L_{t+1}}^{1-\mu}\left({C_{t+1}}^{\mu} {L_{t+1}}^{1-\mu}\right)^{-1+\gamma}\right]=0 \tag{5.12}$$

$$\pi_t-C_t+N_t W_t=0 \tag{5.13}$$

$$U_t-\beta \mathrm{E}_t\left[U_{t+1}\right]-\gamma^{-1}\left({C_t}^{\mu} {L_t}^{1-\mu}\right)^{\gamma}=0 \tag{5.14}$$

$$\beta\left(\left(1-\eta\right)\left(-\mu\mathrm{E}_t\left[W_{t+1}{C_{t+1}}^{-1+\mu}{L_{t+1}}^{1-\mu}\left({C_{t+1}}^{\mu}{L_{t+1}}^{1-\mu}\right)^{-1+\gamma}\right]+\alpha\left(1-\mu\right)\mathrm{E}_t\left[{C_{t+1}}^{\mu}{L_{t+1}}^{-\mu}\left({C_{t+1}}^{\mu}{L_{t+1}}^{1-\mu}\right)^{-1+\gamma}\right]\right)-\eta\left(1-\alpha\right)\left(1-\mu\right)\mathrm{E}_t\left[{C_{t+1}}^{\mu}{L_{t+1}}^{-\mu}\left({C_{t+1}}^{\mu}{L_{t+1}}^{1-\mu}\right)^{-1+\gamma}\right]\right) \tag{5.15}$$

$$1-L_t-\alpha N_t-\eta a_{t-1}\left(1-\alpha\right)=0 \tag{5.16}$$

$$1+\epsilon_t^{\Lambda}-\Lambda_t+\phi^{\mathrm{a}}\left(-1+\Lambda_{t-1}\right)+\phi^{\mathrm{b}}\left(-1+\Lambda_{t-1}\right)=0 \tag{5.17}$$

$$Z_{t-1}-\pi_t+Y_t-Z_t-\psi\left(S_{t-1}+S_{t-1}^{\mathrm{lag}^1}+S_{t-1}^{\mathrm{lag}^2}+S_t\right)-N_tW_t=0 \tag{5.18}$$

6 Steady state relationships (after reduction)

$$-1+\beta\left(1+\sigma{Z_{\mathrm{ss}}}^{-1-\nu}\left(\sigma{Z_{\mathrm{ss}}}^{-\nu}+\left(\Lambda_{\mathrm{ss}}{K_{\mathrm{ss}}}^{\theta}{N_{\mathrm{ss}}}^{1-\theta}\right)^{-\nu}\right)^{-1-\nu^{-1}}\right){C_{\mathrm{ss}}}^{-1+\mu}{C_{\mathrm{ss}}}^{1-\mu}{L_{\mathrm{ss}}}^{-1+\mu}{L_{\mathrm{ss}}}^{1-\mu}=0 \tag{6.1}$$

$$-\psi+\beta\left(-\psi+\lambda_{\mathrm{ss}}^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^1}}}\right){C_{\mathrm{ss}}}^{-1+\mu}{C_{\mathrm{ss}}}^{1-\mu}{L_{\mathrm{ss}}}^{-1+\mu}{L_{\mathrm{ss}}}^{1-\mu}=0 \tag{6.2}$$

$$-\lambda_{\mathrm{ss}}^{\mathrm{FIRM}^2}+\beta\left(\lambda_{\mathrm{ss}}^{\mathrm{FIRM}^2}\left(1-\delta\right)+\theta\Lambda_{\mathrm{ss}}{K_{\mathrm{ss}}}^{-1+\theta}{N_{\mathrm{ss}}}^{1-\theta}\left(\sigma{Z_{\mathrm{ss}}}^{-\nu}+\left(\Lambda_{\mathrm{ss}}{K_{\mathrm{ss}}}^{\theta}{N_{\mathrm{ss}}}^{1-\theta}\right)^{-\nu}\right)^{-1-\nu^{-1}}\left(\Lambda_{\mathrm{ss}}{K_{\mathrm{ss}}}^{\theta}{N_{\mathrm{ss}}}^{1-\theta}\right)^{-1-\nu}\right){C_{\mathrm{ss}}}^{-1+\mu}{C_{\mathrm{ss}}}^{1-\mu}{L_{\mathrm{ss}}}^{-1+\mu}{L_{\mathrm{ss}}}^{1-\mu}=0 \tag{6.3}$$

$$-\lambda_{\mathrm{ss}}^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^1}}}+\beta\left(-\psi+\lambda_{\mathrm{ss}}^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^2}}}\right){C_{\mathrm{ss}}}^{-1+\mu}{C_{\mathrm{ss}}}^{1-\mu}{L_{\mathrm{ss}}}^{-1+\mu}{L_{\mathrm{ss}}}^{1-\mu}=0 \tag{6.4}$$

$$-\lambda_{\mathrm{ss}}^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^2}}}+\beta\left(-\psi+\lambda_{\mathrm{ss}}^{\mathrm{FIRM}^2}\right){C_{\mathrm{ss}}}^{-1+\mu}{C_{\mathrm{ss}}}^{1-\mu}{L_{\mathrm{ss}}}^{-1+\mu}{L_{\mathrm{ss}}}^{1-\mu}=0 \tag{6.5}$$

$$S_{\mathrm{ss}}-S_{\mathrm{ss}}^{\mathrm{lag}^1}=0 \tag{6.6}$$

$$S_{\mathrm{ss}}^{\mathrm{lag}^1}-S_{\mathrm{ss}}^{\mathrm{lag}^2}=0 \tag{6.7}$$

$$-W_{\mathrm{ss}}+\Lambda_{\mathrm{ss}}\left(1-\theta\right){K_{\mathrm{ss}}}^{\theta}{N_{\mathrm{ss}}}^{-\theta}\left(\sigma{Z_{\mathrm{ss}}}^{-\nu}+\left(\Lambda_{\mathrm{ss}}{K_{\mathrm{ss}}}^{\theta}{N_{\mathrm{ss}}}^{1-\theta}\right)^{-\nu}\right)^{-1-\nu^{-1}}\left(\Lambda_{\mathrm{ss}}{K_{\mathrm{ss}}}^{\theta}{N_{\mathrm{ss}}}^{1-\theta}\right)^{-1-\nu}=0 \tag{6.8}$$

$$-Y_{\mathrm{ss}}+\left(\sigma{Z_{\mathrm{ss}}}^{-\nu}+\left(\Lambda_{\mathrm{ss}}{K_{\mathrm{ss}}}^{\theta}{N_{\mathrm{ss}}}^{1-\theta}\right)^{-\nu}\right)^{-\nu^{-1}}=0 \tag{6.9}$$

$$-a_{\mathrm{ss}} + N_{\mathrm{ss}} + a_{\mathrm{ss}} (1 - \eta) = 0 \tag{6.10}$$

$$-\pi_{\mathrm{ss}} + \Pi_{\mathrm{ss}} - \beta \Pi_{\mathrm{ss}} 1 {L_{\mathrm{ss}}}^{-1+\mu} {L_{\mathrm{ss}}}^{1-\mu} = 0 \tag{6.11}$$

$$\pi_{\mathrm{ss}} - C_{\mathrm{ss}} + N_{\mathrm{ss}} W_{\mathrm{ss}} = 0 \tag{6.12}$$

$$-K_{\mathrm{ss}} + {S_{\mathrm{ss}}^{\mathrm{lag}}}^{2} + K_{\mathrm{ss}} (1 - \delta) = 0 \tag{6.13}$$

$$U_{\mathrm{ss}} - \beta U_{\mathrm{ss}} - \gamma^{-1} \left({C_{\mathrm{ss}}}^{\mu} {L_{\mathrm{ss}}}^{1-\mu} \right)^{\gamma} = 0 \tag{6.14}$$

$$\beta \left((1 - \eta) \left(\alpha (1 - \mu) {C_{\mathrm{ss}}}^{\mu} {L_{\mathrm{ss}}}^{-\mu} \left({C_{\mathrm{ss}}}^{\mu} {L_{\mathrm{ss}}}^{1-\mu} \right)^{-1+\gamma} - \mu W_{\mathrm{ss}} {C_{\mathrm{ss}}}^{-1+\mu} {L_{\mathrm{ss}}}^{1-\mu} \left({C_{\mathrm{ss}}}^{\mu} {L_{\mathrm{ss}}}^{1-\mu} \right)^{-1+\gamma} \right) - \eta (1 - \alpha) (1 - \mu) {C_{\mathrm{ss}}}^{\mu} {L_{\mathrm{ss}}}^{-\mu} \left({C_{\mathrm{ss}}}^{\mu} {L_{\mathrm{ss}}}^{1-\mu} \right)^{-1+\gamma} \right) - \alpha (1 - \mu) {C_{\mathrm{ss}}}^{\mu} {L_{\mathrm{ss}}}^{-\mu} \left({C_{\mathrm{ss}}}^{\mu} {L_{\mathrm{ss}}}^{1-\mu} \right)^{-} \tag{6.15}$$

$$1 - L_{\mathrm{ss}} - \alpha N_{\mathrm{ss}} - \eta a_{\mathrm{ss}} (1 - \alpha) = 0 \tag{6.16}$$

$$1 - \Lambda_{\mathrm{ss}} + \phi^{\mathrm{a}} (-1 + \Lambda_{\mathrm{ss}}) + \phi^{\mathrm{b}} (-1 + \Lambda_{\mathrm{ss}}) = 0 \tag{6.17}$$

$$-\pi_{\mathrm{ss}} + Y_{\mathrm{ss}} - \psi \left(2 S_{\mathrm{ss}} + S_{\mathrm{ss}}^{\mathrm{lag}^{1}} + S_{\mathrm{ss}}^{\mathrm{lag}^{2}} \right) - N_{\mathrm{ss}} W_{\mathrm{ss}} = 0 \tag{6.18}$$

7 Parameter settings

$$\alpha = 1 \tag{7.1}$$

$$\beta = 0.99 \tag{7.2}$$

$$\delta = 0.025 \tag{7.3}$$

$$\eta = 0.5 \tag{7.4}$$

$$\gamma = -1 \tag{7.5}$$

$$\mu = 0.34 \tag{7.6}$$

$$\nu = 3 \tag{7.7}$$

$$\phi^{\mathrm{a}} = 0.906 \tag{7.8}$$

$$\phi^{\mathrm{b}} = 0.088 \tag{7.9}$$

$$\psi = 0.25 \tag{7.10}$$

$$\sigma = 0.01 \tag{7.11}$$

$$\theta = 0.36 \tag{7.12}$$

8 Steady-state values

	Steady-state value
a	0.6064
π	0.1283
C	0.8261
K	11.0149
L	0.6968
Λ	1
N	0.3032
Π	12.8257
S	0.2754
S^{lag^1}	0.2754
S^{lag^2}	0.2754
U	-135.4461
W	2.3014
Y	1.1015
Z	1.0987

9 The solution of the 1st order perturbation

Matrix P

$$\begin{array}{c} \\ a_t \\ K_t \\ \Lambda_t \\ S_t \\ S_t^{\text{lag}^1} \\ S_t^{\text{lag}^2} \\ Z_t \end{array} \begin{array}{c} \begin{array}{ccccccc} a_{t-1} & K_{t-1} & \Lambda_{t-1} & S_{t-1} & S_{t-1}^{\text{lag}^1} & S_{t-1}^{\text{lag}^2} & Z_{t-1} \end{array} \\ \begin{pmatrix} 0.5 & -0.0601 & 0.1549 & -0.0012 & -0.0024 & -0.0037 & -0.0086 \\ 0 & 0.975 & 0 & 0 & 0 & 0.025 & 0 \\ 0 & 0 & 0.994 & 0 & 0 & 0 & 0 \\ 0 & -8.077 & 6.257 & -1.0496 & -1.0055 & -0.8423 & 8.6102 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0.453 & 0.2652 & 0.0002 & -0.0056 & -0.0193 & 0.4187 \end{pmatrix} \end{array}$$

Matrix Q

$$\begin{array}{c} \\ a \\ K \\ \Lambda \\ S \\ S^{\text{lag}^1} \\ S^{\text{lag}^2} \\ Z \end{array} \begin{array}{c} \begin{array}{c} \epsilon^{\Lambda} \end{array} \\ \begin{pmatrix} 0.1558 \\ 0 \\ 1 \\ 6.2947 \\ 0 \\ 0 \\ 0.2668 \end{pmatrix} \end{array}$$

Matrix R

$$\begin{array}{c} \\ \lambda_t^{\text{FIRM}^2} \\ \lambda_t^{\text{FIRM}^{\text{S}^{\text{lag}^1}}} \\ \lambda_t^{\text{FIRM}^{\text{S}^{\text{lag}^2}}} \\ \pi_t \\ C_t \\ L_t \\ N_t \\ \Pi_t \\ U_t \\ W_t \\ Y_t \end{array} \begin{array}{c} \begin{array}{ccccccc} a_{t-1} & K_{t-1} & \Lambda_{t-1} & S_{t-1} & S_{t-1}^{\text{lag}^1} & S_{t-1}^{\text{lag}^2} & Z_{t-1} \end{array} \\ \begin{pmatrix} 0 & -0.0493 & 0.0617 & -0.0009 & -0.0019 & -0.0025 & 0.0167 \\ 0 & -0.0227 & 0.025 & -0.0016 & -0.0017 & -0.0015 & 0.0126 \\ 0 & -0.0376 & 0.044 & -0.0012 & -0.0024 & -0.0022 & 0.0165 \\ 0 & 1.3828 & -1.7195 & 0.0202 & 0.041 & 0.0647 & 0.1891 \\ 0 & 0.4442 & 0.6996 & 0.0019 & 0.0039 & 0.0062 & 0.0545 \\ 0 & 0.0523 & -0.1348 & 0.001 & 0.0021 & 0.0033 & 0.0075 \\ 0 & -0.1202 & 0.3098 & -0.0023 & -0.0048 & -0.0075 & -0.0172 \\ 0 & 0.8155 & 0.0939 & 0.0046 & 0.0091 & 0.014 & 0.0989 \\ 0 & 0.0465 & 0.2798 & 0.0003 & 0.0006 & 0.0009 & 0.0046 \\ 0 & 0.3919 & 0.8344 & 0.0009 & 0.0018 & 0.0029 & 0.047 \\ 0 & 0.2802 & 1.1803 & -0.0015 & -0.003 & -0.0047 & -0.0008 \end{pmatrix} \end{array}$$

Matrix S

$$\begin{array}{l} \\ \lambda^{\mathrm{FIRM}^2} \\ \lambda^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^1}}} \\ \lambda^{\mathrm{FIRM}^{\mathrm{S}^{\mathrm{lag}^2}}} \\ \pi \\ C \\ L \\ N \\ \Pi \\ U \\ W \\ Y \end{array} \begin{array}{c} \epsilon^{\Lambda} \\ \left(\begin{array}{c} 0.0621 \\ 0.0252 \\ 0.0443 \\ -1.7299 \\ 0.7038 \\ -0.1356 \\ 0.3117 \\ 0.0945 \\ 0.2815 \\ 0.8395 \\ 1.1874 \end{array} \right) \end{array}$$

10 Model statistics

10.1 Basic statistics

	Steady-state value	Std. dev.	Variance	Loglin
C	0.8261	0.2883	0.0831	Y
K	11.0149	0.093	0.0087	Y
L	0.6968	0.0533	0.0028	Y
Λ	1	0.4096	0.1678	Y
N	0.3032	0.1225	0.015	Y
U	-135.4461	0.1153	0.0133	Y
Y	1.1015	0.4723	0.2231	Y
W	2.3014	0.3399	0.1155	Y

10.2 Correlation matrix

	C	K	L	Λ	N	U	W	Y
C	1	-0.069	-0.961	0.989	0.961	0.994	0.999	0.994
K		1	0.312	-0.207	-0.312	-0.171	-0.107	-0.167
L			1	-0.989	-1	-0.984	-0.972	-0.986
Λ				1	0.989	0.999	0.994	0.998
N					1	0.984	0.972	0.986
U						1	0.997	0.999
W							1	0.998
Y								1

10.3 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}
C_t	0.61	-0.046	0.088	0.23	0.427	0.681	0.994	0.744	0.526	0.345	0.198	0.072
K_t	0.197	-0.465	-0.472	-0.45	-0.391	-0.291	-0.167	0.018	0.278	0.619	0.61	0.568
L_t	0.113	-0.086	-0.213	-0.337	-0.507	-0.725	-0.986	-0.636	-0.361	-0.163	-0.045	0.09
Λ_t	0.867	0.029	0.16	0.295	0.479	0.714	0.998	0.71	0.467	0.265	0.102	-0.026
N_t	0.259	0.086	0.213	0.337	0.507	0.725	0.986	0.636	0.361	0.163	0.045	-0.09
U_t	0.244	0.01	0.142	0.279	0.467	0.707	0.999	0.722	0.485	0.288	0.127	-0.001
W_t	0.72	-0.025	0.108	0.248	0.442	0.691	0.998	0.731	0.503	0.318	0.175	0.047
Y_t	1	0.007	0.139	0.275	0.463	0.705	1	0.705	0.463	0.275	0.139	0.007

10.4 Autocorrelations

	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5
C	0.73	0.499	0.307	0.153	0.024
K	0.867	0.72	0.614	0.53	0.368
L	0.681	0.426	0.242	0.133	-0.001
Λ	0.721	0.484	0.286	0.125	-0.002
N	0.681	0.426	0.242	0.133	-0.001
U	0.724	0.488	0.291	0.13	0.002
W	0.721	0.485	0.294	0.147	0.016
Y	0.705	0.463	0.275	0.139	0.007

11 Impulse response functions

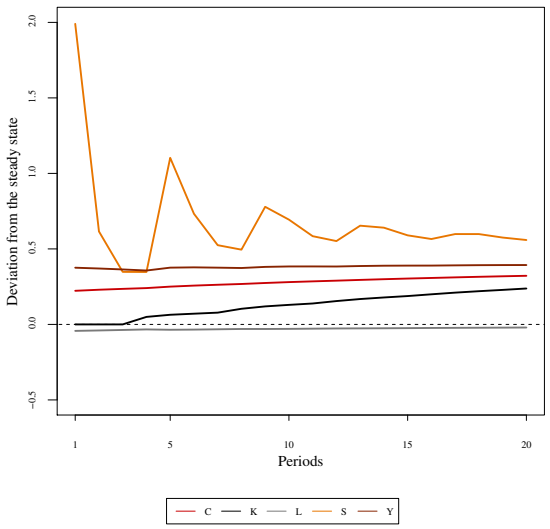

Figure 1: Impulse responses (C, K, L, S, Y) to ϵ^{Λ} shock

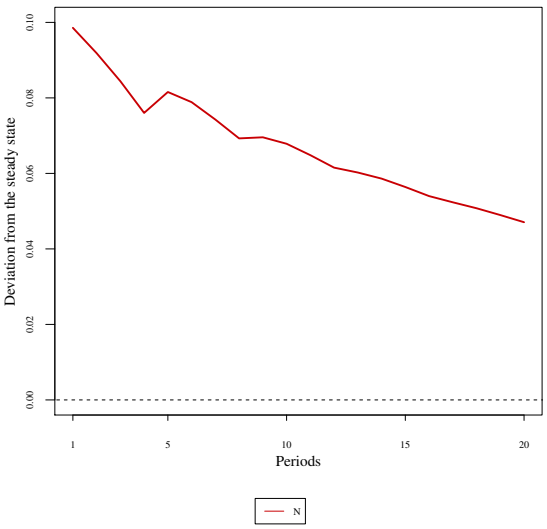

Figure 2: Impulse response (N) to ϵ^{Λ} shock