

## 1 CONSUMER

### 1.1 Optimisation problem

$$\max_{C_t, N_t, a_t, L_t} U_t = \beta E_t [U_{t+1}] + \gamma^{-1} (C_t^\mu L_t^{1-\mu})^\gamma \quad (1.1)$$

s.t. :

$$C_t = \pi_t + N_t W_t \quad (\lambda_t^c) \quad (1.2)$$

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

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

### 1.2 First order conditions

$$\beta - \lambda_t^U = 0 \quad (U_t) \quad (1.5)$$

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

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

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

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

## 2 FIRM

### 2.1 Optimisation problem

$$\max_{K_t, N_t^d, Z_t, Y_t, S_t, X_t, \pi_t, S_t^{\text{lag}^1}, S_t^{\text{lag}^2}} \Pi_t = \pi_t + \lambda_t^c \lambda_t^U \mathbf{E}_t [\lambda_{t+1}^c \lambda_{t+1}^U \Pi_{t+1}] \quad (2.1)$$

s.t. :

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

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

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

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

### 2.2 First order conditions

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

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

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

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

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

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

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

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

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

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

### 2.3 First order conditions after reduction

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

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

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

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

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

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

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

## 3 EQUILIBRIUM

### 3.1 Identities

$$N_t^{\text{d}} = N_t \quad (3.1)$$

## 4 EXOG

### 4.1 Identities

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

## 5 Equilibrium relationships (after reduction)

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

$$-\psi + \beta C_t^{1-\mu} L_t^{-1+\mu} (C_t^\mu L_t^{1-\mu})^{1-\gamma} \mathbb{E}_t \left[ \left( -\psi + \lambda_{t+1}^{\text{FIRM}^{\text{slag}^1}} \right) C_{t+1}^{-1+\mu} L_{t+1}^{1-\mu} (C_{t+1}^\mu L_{t+1}^{1-\mu})^{-1+\gamma} \right] = 0 \quad (5.2)$$

$$S_{t-1} - S_t^{\text{lag}^1} = 0 \quad (5.3)$$

$$S_{t-1}^{\text{lag}^1} - S_t^{\text{lag}^2} = 0 \quad (5.4)$$

$$-\lambda_t^{\text{FIRM}^2} + \beta C_t^{1-\mu} L_t^{-1+\mu} (C_t^\mu L_t^{1-\mu})^{1-\gamma} \mathbb{E}_t \left[ \left( \lambda_{t+1}^{\text{FIRM}^2} (1-\delta) + \theta \Lambda_{t+1} K_t^{-1+\theta} N_{t+1}^{1-\theta} \left( \sigma Z_t^{-\nu} + \left( \Lambda_{t+1} K_t^\theta N_{t+1}^{1-\theta} \right)^{-\nu} \right)^{-1-\nu^{-1}} \left( \Lambda_{t+1} K_t^\theta N_{t+1}^{1-\theta} \right)^{-1-\nu} \right) C_{t+1}^{-1+\mu} L_{t+1}^{1-\mu} (C_{t+1}^\mu L_{t+1}^{1-\mu})^{-1+\gamma} \right] = 0 \quad (5.5)$$

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

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

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

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

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

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

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

$$\pi_t - C_t + N_t W_t = 0 \quad (5.13)$$

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

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

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

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

$$Z_{t-1} - \pi_t + Y_t - Z_t - \psi \left( S_{t-1} + S_{t-1}^{\text{lag}^1} + S_{t-1}^{\text{lag}^2} + S_t \right) - N_t W_t = 0 \quad (5.18)$$

## 6 Steady state relationships (after reduction)

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

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

$$S_{\text{ss}} - S_{\text{ss}}^{\text{lag}^1} = 0 \quad (6.3)$$

$$S_{\text{ss}}^{\text{lag}^1} - S_{\text{ss}}^{\text{lag}^2} = 0 \quad (6.4)$$

$$-\lambda_{\text{ss}}^{\text{FIRM}^2} + \beta \left( \lambda_{\text{ss}}^{\text{FIRM}^2} (1-\delta) + \theta \Lambda_{\text{ss}} K_{\text{ss}}^{-1+\theta} N_{\text{ss}}^{1-\theta} \left( \sigma Z_{\text{ss}}^{-\nu} + \left( \Lambda_{\text{ss}} K_{\text{ss}}^\theta N_{\text{ss}}^{1-\theta} \right)^{-\nu} \right)^{-1-\nu^{-1}} \left( \Lambda_{\text{ss}} K_{\text{ss}}^\theta N_{\text{ss}}^{1-\theta} \right)^{-1-\nu} \right) C_{\text{ss}}^{-1+\mu} C_{\text{ss}}^{1-\mu} L_{\text{ss}}^{-1+\mu} L_{\text{ss}}^{1-\mu} = 0 \quad (6.5)$$

$$-\lambda_{\text{ss}}^{\text{FIRM}^{\text{S}^{\text{lag}^1}}} + \beta \left( -\psi + \lambda_{\text{ss}}^{\text{FIRM}^{\text{S}^{\text{lag}^2}}} \right) C_{\text{ss}}^{-1+\mu} C_{\text{ss}}^{1-\mu} L_{\text{ss}}^{-1+\mu} L_{\text{ss}}^{1-\mu} = 0 \quad (6.6)$$

$$-\lambda_{\text{ss}}^{\text{FIRM}^{\text{S}^{\text{lag}^2}}} + \beta \left( -\psi + \lambda_{\text{ss}}^{\text{FIRM}^2} \right) C_{\text{ss}}^{-1+\mu} C_{\text{ss}}^{1-\mu} L_{\text{ss}}^{-1+\mu} L_{\text{ss}}^{1-\mu} = 0 \quad (6.7)$$

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

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

$$-K_{ss} + S_{ss}^{\text{lag}^2} + K_{ss}(1 - \delta) = 0 \quad (6.10)$$

$$-a_{ss} + N_{ss} + a_{ss}(1 - \eta) = 0 \quad (6.11)$$

$$-\pi_{ss} + \Pi_{ss} - \beta \Pi_{ss} 1 L_{ss}^{-1+\mu} L_{ss}^{1-\mu} = 0 \quad (6.12)$$

$$\pi_{ss} - C_{ss} + N_{ss} W_{ss} = 0 \quad (6.13)$$

$$U_{ss} - \beta U_{ss} - \gamma^{-1} (C_{ss}^\mu L_{ss}^{1-\mu})^\gamma = 0 \quad (6.14)$$

$$\beta \left( (1 - \eta) \left( \alpha (1 - \mu) C_{ss}^\mu L_{ss}^{-\mu} (C_{ss}^\mu L_{ss}^{1-\mu})^{-1+\gamma} - \mu W_{ss} C_{ss}^{-1+\mu} L_{ss}^{1-\mu} (C_{ss}^\mu L_{ss}^{1-\mu})^{-1+\gamma} \right) - \eta (1 - \alpha) (1 - \mu) C_{ss}^\mu L_{ss}^{-\mu} (C_{ss}^\mu L_{ss}^{1-\mu})^{-1+\gamma} \right) - \alpha (1 - \mu) C_{ss}^\mu L_{ss}^{-\mu} (C_{ss}^\mu L_{ss}^{1-\mu})^{-1+\gamma} = 0 \quad (6.15)$$

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

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

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

## 7 Parameter settings

$$\alpha = 1 \quad (7.1)$$

$$\beta = 0.99 \quad (7.2)$$

$$\delta = 0.025 \quad (7.3)$$

$$\eta = 0.5 \quad (7.4)$$

$$\gamma = -1 \quad (7.5)$$

$$\mu = 0.34 \quad (7.6)$$

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

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

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

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

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

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

## 8 Steady-state values

	Steady-state value
$a$	0.6064
$\pi$	0.1283
$C$	0.8261
$K$	11.0149
$L$	0.6968
$\Lambda$	1
$N$	0.3032
$\Pi$	12.8257
$S$	0.2754
$S^{\text{lag}^1}$	0.2754
$S^{\text{lag}^2}$	0.2754
$U$	-135.4461
$W$	2.3014
$Y$	1.1015
$Z$	1.0987

## 9 The solution of the 1st order perturbation

Matrix  $P$

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

Matrix  $Q$

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

Matrix  $R$

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



## Matrix $S$

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

## 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
$\Lambda$	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

	$C$	$K$	$L$	$\Lambda$	$N$	$U$	$W$	$Y$
$C$	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
$\Lambda$				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
$\Lambda_t$	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
<i>C</i>	0.73	0.499	0.307	0.153	0.024
<i>K</i>	0.867	0.72	0.614	0.53	0.368
<i>L</i>	0.681	0.426	0.242	0.133	-0.001
$\Lambda$	0.721	0.484	0.286	0.125	-0.002
<i>N</i>	0.681	0.426	0.242	0.133	-0.001
<i>U</i>	0.724	0.488	0.291	0.13	0.002
<i>W</i>	0.721	0.485	0.294	0.147	0.016
<i>Y</i>	0.705	0.463	0.275	0.139	0.007

# 11 Impulse response functions

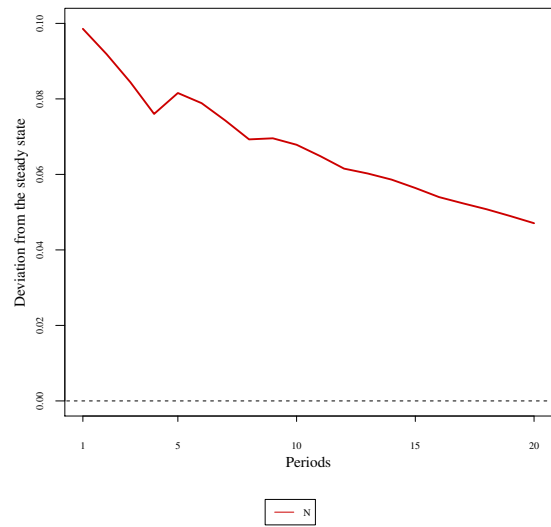
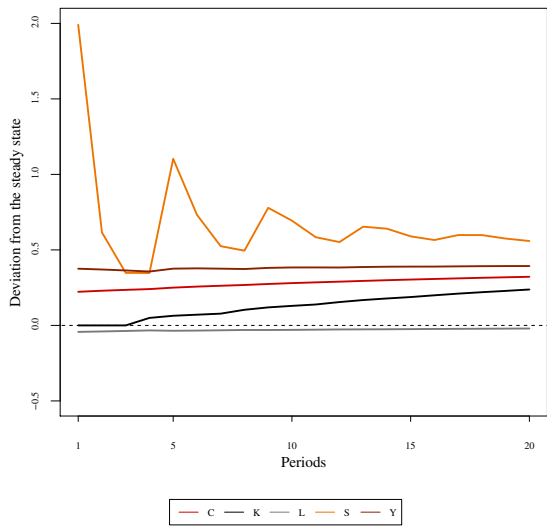


Figure 1: Impulse responses ( $C, K, L, S, Y$ ) to  $\epsilon^\Lambda$  shock

Figure 2: Impulse response ( $N$ ) to  $\epsilon^\Lambda$  shock