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Model name: `rbc_ic`

1 CONSUMER

1.1 Optimization problem

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

s.t. :

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

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

1.2 First order conditions

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

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

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

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

2 FIRM

2.1 Optimization problem

$$\max_{K_t^d, L_t^d, Y_t} \pi_t = Y_t - L_t^d W_t - r_t K_t^d \tag{2.1}$$

s.t. :

$$Y_t = Z_t K_t^{d\alpha} L_t^{d1-\alpha} \quad (\lambda_t^{\mathrm{FIRM}^1}) \tag{2.2}$$

2.2 First order conditions

$$-r_t + \alpha \lambda_t^{\mathrm{FIRM}^1} Z_t K_t^{d-1+\alpha} L_t^{d1-\alpha} = 0 \quad (K_t^d) \tag{2.3}$$

$$-W_t + \lambda_t^{\mathrm{FIRM}^1} Z_t (1 - \alpha) K_t^{d\alpha} L_t^{d-\alpha} = 0 \quad (L_t^d) \tag{2.4}$$

$$1 - \lambda_t^{\mathrm{FIRM}^1} = 0 \quad (Y_t) \tag{2.5}$$

2.3 First order conditions after reduction

$$-r_t + \alpha Z_t K_t^{d-1+\alpha} L_t^{d1-\alpha} = 0 \quad (K_t^d) \tag{2.6}$$

$$-W_t + Z_t (1 - \alpha) K_t^{d\alpha} L_t^{d-\alpha} = 0 \quad (L_t^d) \tag{2.7}$$

3 EQUILIBRIUM

3.1 Identities

$$K_t^d = K_{t-1}^s \tag{3.1}$$

$$L_t^d = L_t^s \tag{3.2}$$

4 EXOG

4.1 Identities

$$Z_t = e^{\epsilon_t^Z + \phi \log Z_{t-1}} \tag{4.1}$$

5 Equilibrium relationships

$$-r_t + \alpha Z_t K_{t-1}^{s\ -1+\alpha} L_t^{s\,1-\alpha} = 0 \tag{5.1}$$

$$-W_t + Z_t \left(1-\alpha\right) K_{t-1}^{s\ \alpha} L_t^{s\ -\alpha} = 0 \tag{5.2}$$

$$-Y_t + Z_t K_{t-1}^{s\ \alpha} L_t^{s\,1-\alpha} = 0 \tag{5.3}$$

$$Z_t - e^{\epsilon_t^Z + \phi \log Z_{t-1}} = 0 \tag{5.4}$$

$$\beta \left(\mu \mathrm{E}_t \left[\left(r_{t+1} - \psi \left(-\delta + K_t^{s-1} I_{t+1} \right)^2 + 2\psi K_t^{s-1} I_{t+1} \left(-\delta + K_t^{s-1} I_{t+1} \right) \right) C_{t+1}^{-1+\mu} (1-L_{t+1}^s)^{1-\mu} \left(C_{t+1}^{\mu} (1-L_{t+1}^s)^{1-\mu} \right)^{-\eta} \right] - \tag{5.5}$$

$$(-1+\mu)(1-L_t^s)^{-\mu}\left((1-L_t^s)^{1-\mu}C_t^{\mu}\right)^{-\eta}C_t^{\mu} + \mu W_t C_t^{-1+\mu}(1-L_t^s)^{1-\mu}\left((1-L_t^s)^{1-\mu}C_t^{\mu}\right)^{-\eta} = 0 \tag{5.6}$$

$$I_t - K_t^s + K_{t-1}^s \left(1-\delta\right) = 0 \tag{5.7}$$

$$U_t - \beta \mathrm{E}_t \left[U_{t+1}\right] - (1-\eta)^{-1}\left((1-L_t^s)^{1-\mu}C_t^{\mu}\right)^{1-\eta} = 0 \tag{5.8}$$

$$-C_t - I_t + Y_t - \psi K_{t-1}^s \left(-\delta + K_{t-1}^{s\ -1} I_t\right)^2 = 0 \tag{5.9}$$

6 Steady state relationships

$$-r_{ss} + \alpha Z_{ss} K_{ss}^{s\ -1+\alpha} L_{ss}^{s\ 1-\alpha} = 0 \tag{6.1}$$

$$-W_{ss} + Z_{ss} \left(1-\alpha\right) K_{ss}^{s\ \alpha} L_{ss}^{s\ -\alpha} = 0 \tag{6.2}$$

$$-Y_{ss} + Z_{ss} K_{ss}^{s\ \alpha} L_{ss}^{s\ 1-\alpha} = 0 \tag{6.3}$$

$$Z_{ss} - e^{\phi \log Z_{ss}} = 0 \tag{6.4}$$

$$\beta \left(\mu \left(r_{ss} - \psi \left(-\delta + I_{ss} K_{ss}^{s-1} \right)^2 + 2\psi I_{ss} K_{ss}^{s-1} \left(-\delta + I_{ss} K_{ss}^{s-1} \right) \right) C_{ss}^{-1+\mu}(1-L_{ss}^s)^{1-\mu} \left(C_{ss}^{\mu}(1-L_{ss}^s)^{1-\mu} \right)^{-\eta} - \mu \left(-1 - 2\psi \left(-\delta \right. \right. \tag{6.5}$$

$$(-1+\mu) C_{ss}^{\mu}(1-L_{ss}^s)^{-\mu}\left(C_{ss}^{\mu}(1-L_{ss}^s)^{1-\mu}\right)^{-\eta} + \mu W_{ss} C_{ss}^{-1+\mu}(1-L_{ss}^s)^{1-\mu}\left(C_{ss}^{\mu}(1-L_{ss}^s)^{1-\mu}\right)^{-\eta} = 0 \tag{6.6}$$

$$I_{ss} - K_{ss}^s + K_{ss}^s \left(1-\delta\right) = 0 \tag{6.7}$$

$$U_{ss} - \beta U_{ss} - (1-\eta)^{-1}\left(C_{ss}^{\mu}(1-L_{ss}^s)^{1-\mu}\right)^{1-\eta} = 0 \tag{6.8}$$

$$-C_{ss} - I_{ss} + Y_{ss} - \psi K_{ss}^s \left(-\delta + I_{ss} K_{ss}^{s\ -1}\right)^2 = 0 \tag{6.9}$$

7 Calibrating equations

$$-0.36 Y_{\text{ss}} + r_{\text{ss}} K_{\text{ss}}^s = 0 \tag{7.1}$$

8 Parameter settings

$$\beta = 0.99 \tag{8.1}$$
$$\delta = 0.025 \tag{8.2}$$
$$\eta = 2 \tag{8.3}$$
$$\mu = 0.3 \tag{8.4}$$
$$\phi = 0.95 \tag{8.5}$$
$$\psi = 0.8 \tag{8.6}$$

9 Steady state values

	Steady state values
r	0.0351
C	0.7422
I	0.2559
K^s	10.2368
L^s	0.2695
U	-136.2372
W	2.3706
Y	0.9981
Z	1

10 Statistics of the model

10.1 Moments

	Steady state value	Std. dev.	Variance	Loglinear
r	0.0351	0.1814	0.0329	Y
C	0.7422	0.0783	0.0061	Y
I	0.2559	0.4741	0.2248	Y
K^s	10.2368	0.0422	0.0018	Y
L^s	0.2695	0.0749	0.0056	Y
U	-136.2372	0.009	0.0001	Y
W	2.3706	0.1047	0.011	Y
Y	0.9981	0.1781	0.0317	Y
Z	1	0.1303	0.017	Y

10.2 Correlation matrix

	r	C	I	K^s	L^s	U	W	Y	Z
r	1	0.9082	0.9901	0.0897	0.9965	-0.9321	0.9422	0.9726	0.9851
C	0.9082	1	0.9579	0.4983	0.9402	-0.9981	0.996	0.9806	0.9667
I	0.9901	0.9579	1	0.2284	0.9984	-0.9736	0.9798	0.9956	0.9995
K^s	0.0897	0.4983	0.2284	1	0.1733	-0.4445	0.4184	0.3187	0.2599
L^s	0.9965	0.9402	0.9984	0.1733	1	-0.9592	0.967	0.9887	0.9961
U	-0.9321	-0.9981	-0.9736	-0.4445	-0.9592	1	-0.9996	-0.9907	-0.9805
W	0.9422	0.996	0.9798	0.4184	0.967	-0.9996	1	0.9942	0.9858
Y	0.9726	0.9806	0.9956	0.3187	0.9887	-0.9907	0.9942	1	0.9981
Z	0.9851	0.9667	0.9995	0.2599	0.9961	-0.9805	0.9858	0.9981	1

10.3 Autocorrelations

	$t-1$	$t-2$	$t-3$	$t-4$	$t-5$
r	0.7103	0.4664	0.2655	0.1042	-0.0215
C	0.7446	0.5209	0.3292	0.1686	0.0376
I	0.7115	0.4684	0.2679	0.1066	-0.0193
K^s	0.9598	0.8626	0.7281	0.5723	0.4082
L^s	0.7098	0.4657	0.2647	0.1034	-0.0223
U	0.7346	0.505	0.3106	0.1498	0.0204
W	0.7304	0.4983	0.3028	0.1419	0.0131
Y	0.7179	0.4786	0.2798	0.1186	-0.0083
Z	0.7133	0.4711	0.2711	0.1098	-0.0163

11 Statistics of the model

11.1 Moments relative to moments of the reference variable

	Steady state value relative to Y	Std. dev. relative to Y	Variance relative to Y	Loglinear
r	0.0352	1.0184	1.0372	Y
C	0.7436	0.4395	0.1931	Y
I	0.2564	2.6621	7.0869	Y
K^s	10.2561	0.2368	0.0561	Y
L^s	0.27	0.4205	0.1768	Y
U	-136.4937	0.0504	0.0025	Y
W	2.3751	0.5877	0.3453	Y
Y	1	1	1	Y
Z	1.0019	0.7319	0.5357	Y

11.2 Correlations with the reference variable

	Y_{t-5}	Y_{t-4}	Y_{t-3}	Y_{t-2}	Y_{t-1}	Y_t	Y_{t+1}	Y_{t+2}	Y_{t+3}	Y_{t+4}	Y_{t+5}
r	0.1089	0.228	0.3727	0.5446	0.7446	0.9726	0.6308	0.3527	0.1323	-0.0369	-0.1614
C	-0.1067	0.0213	0.1894	0.4025	0.665	0.9806	0.7609	0.5644	0.3923	0.2448	0.1212
I	0.039	0.1636	0.3192	0.5084	0.7335	0.9956	0.6875	0.4309	0.222	0.0566	-0.0702
K^s	-0.4795	-0.4216	-0.3213	-0.1704	0.0399	0.3187	0.5039	0.6124	0.6595	0.6589	0.6227
L^s	0.0671	0.1898	0.3414	0.5242	0.7397	0.9887	0.6664	0.4006	0.1865	0.0192	-0.1069
U	0.0765	-0.0517	-0.2183	-0.4279	-0.6842	-0.9907	-0.7507	-0.54	-0.3589	-0.2065	-0.0814
W	-0.0621	0.066	0.2318	0.4393	0.6925	0.9942	0.7449	0.5278	0.3426	0.1881	0.0624
Y	-0.0083	0.1186	0.2798	0.4786	0.7179	1	0.7179	0.4786	0.2798	0.1186	-0.0083
Z	0.0226	0.1481	0.3058	0.4986	0.7288	0.9981	0.6988	0.4479	0.2423	0.0782	-0.0488

12 Impulse response functions
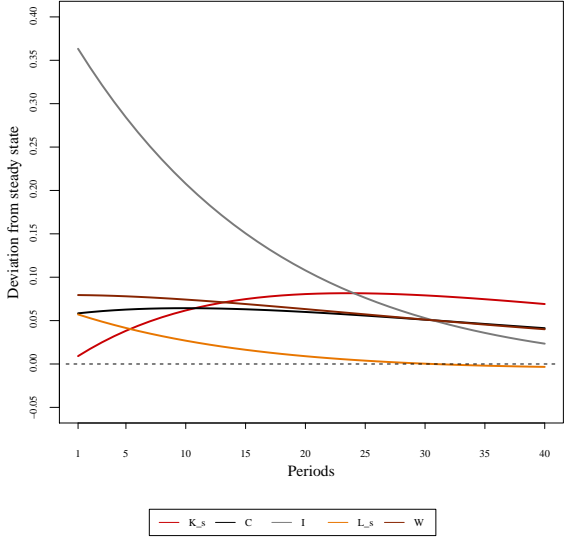
12.1 Shock ϵ^Z
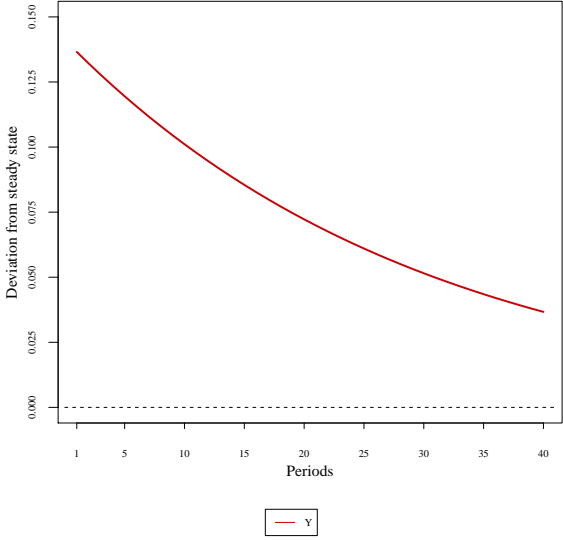

Figure 1: Impulse response function for ϵ^Z shock

Figure 2: Impulse response function for ϵ^Z shock