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Model name: RW

1 RW

1.1 Optimisation problem

$$\max_{\pi_t, y_t, i_t} U_t = -0.5\left(-pistar + \pi_t\right)^2 + \beta \mathrm{E}_t\left[U_{t+1}\right] - 0.5\kappa\theta^{-1}{y_t}^2 \tag{1.1}$$

s.t. :

$$\pi_{t-1} = etapi_{t-1} + \beta\pi_t + \kappa y_{t-1} \quad \left(\lambda_t^{\mathrm{RW}^1}\right) \tag{1.2}$$

$$y_{t-1} = y_t - \sigma\left(i_{t-1} - \pi_t\right) \quad \left(\lambda_t^{\mathrm{RW}^2}\right) \tag{1.3}$$

1.2 First order conditions

$$pistar - \pi_t + \beta\lambda_t^{\mathrm{RW}^1} - \beta \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{RW}^1}\right] + \sigma\lambda_t^{\mathrm{RW}^2} = 0 \quad (\pi_t) \tag{1.4}$$

$$\lambda_t^{\mathrm{RW}^2} + \beta\left(\kappa \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{RW}^1}\right] - \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{RW}^2}\right]\right) - \kappa\theta^{-1} y_t = 0 \quad (y_t) \tag{1.5}$$

$$-\beta\sigma \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{RW}^2}\right] = 0 \quad (i_t) \tag{1.6}$$

2 EXOG

2.1 Identities

$$etapi_t = e^{\epsilon_t^{\pi} + \phi \log etapi_{t-1}} \tag{2.1}$$

3 Equilibrium relationships (after reduction)

$$-etapi_t + e^{\epsilon_t^{\pi} + \phi \log etapi_{t-1}} = 0 \tag{3.1}$$

$$-y_{t-1} + y_t - \sigma\left(i_{t-1} - \pi_t\right) = 0 \tag{3.2}$$

$$\lambda_t^{\mathrm{RW}^2} + \beta\left(\kappa \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{RW}^1}\right] - \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{RW}^2}\right]\right) - \kappa\theta^{-1} y_t = 0 \tag{3.3}$$

$$etapi_{t-1} - \pi_{t-1} + \beta\pi_t + \kappa y_{t-1} = 0 \tag{3.4}$$

$$U_t + 0.5\left(-pistar + \pi_t\right)^2 - \beta \mathrm{E}_t\left[U_{t+1}\right] + 0.5\kappa\theta^{-1}{y_t}^2 = 0 \tag{3.5}$$

$$pistar - \pi_t + \beta\lambda_t^{\mathrm{RW}^1} - \beta \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{RW}^1}\right] + \sigma\lambda_t^{\mathrm{RW}^2} = 0 \tag{3.6}$$

$$-\beta\sigma \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{RW}^2}\right] = 0 \tag{3.7}$$

4 Steady state relationships (after reduction)

$$-etapi_{\mathrm{ss}} + e^{\phi \log etapi_{\mathrm{ss}}} = 0 \tag{4.1}$$

$$-\sigma\left(i_{\mathrm{ss}} - \pi_{\mathrm{ss}}\right) = 0 \tag{4.2}$$

$$\lambda_{\mathrm{ss}}^{\mathrm{RW}^2} + \beta\left(-\lambda_{\mathrm{ss}}^{\mathrm{RW}^2} + \kappa\lambda_{\mathrm{ss}}^{\mathrm{RW}^1}\right) - \kappa\theta^{-1} y_{\mathrm{ss}} = 0 \tag{4.3}$$

$$etapi_{\mathrm{ss}} - \pi_{\mathrm{ss}} + \beta\pi_{\mathrm{ss}} + \kappa y_{\mathrm{ss}} = 0 \tag{4.4}$$

$$U_{\mathrm{ss}} + 0.5\left(-pistar + \pi_{\mathrm{ss}}\right)^2 - \beta U_{\mathrm{ss}} + 0.5\kappa\theta^{-1} {y_{\mathrm{ss}}}^2 = 0 \tag{4.5}$$

$$pistar - \pi_{\mathrm{ss}} + \sigma\lambda_{\mathrm{ss}}^{\mathrm{RW}^2} = 0 \tag{4.6}$$

$$-\beta\sigma\lambda_{\mathrm{ss}}^{\mathrm{RW}^2} = 0 \tag{4.7}$$

5 Parameter settings

$$\beta = 0.99 \tag{5.1}$$

$$\kappa = 0.2465 \tag{5.2}$$

$$\phi = 0.95 \tag{5.3}$$

$$pistar = 0 \tag{5.4}$$

$$\sigma = 1 \tag{5.5}$$

$$\theta = 6 \tag{5.6}$$

6 Steady-state values

	Steady-state value
$etaqpi$	1
i	0
λ^{RW^1}	-0.683
λ^{RW^2}	0
π	0
y	-4.0568
U	-33.8066

7 The solution of the 1st order perturbation

Matrix P

$$\begin{array}{c} \\ etaqpi \\ i \\ \pi \\ y \end{array} \begin{array}{c} \begin{array}{cccc} etaqpi_{t-1} & i_{t-1} & \pi_{t-1} & y_{t-1} \end{array} \\ \begin{pmatrix} 0.95 & 0 & 0 & 0 \\ -13.033 & -1.9422 & 5.8225 & -13.7015 \\ -1.0101 & 0 & 1.0101 & -1.0101 \\ 0.249 & 0.2465 & -0.249 & 1.249 \end{pmatrix} \end{array}$$

Matrix Q

$$\begin{array}{c} \\ etaqpi \\ i \\ \pi \\ y \end{array} \begin{array}{c} \begin{array}{c} \epsilon^{\pi} \end{array} \\ \begin{pmatrix} 1 \\ -7.59 \\ 0 \\ 0 \end{pmatrix} \end{array}$$

Matrix R

$$\begin{array}{c} \\ \lambda_t^{\mathrm{RW}^1} \\ \lambda_t^{\mathrm{RW}^2} \\ U_t \end{array} \begin{array}{c} \begin{array}{cccc} etaqpi_{t-1} & i_{t-1} & \pi_{t-1} & y_{t-1} \end{array} \\ \begin{pmatrix} -8.6776 & -0.7328 & 4.9879 & -7.9606 \\ 0.9938 & 0.1309 & -0.5005 & 1.0316 \\ -0.3395 & 0 & 0.0202 & -0.0202 \end{pmatrix} \end{array}$$

Matrix S

$$\begin{array}{c} \\ \lambda^{\mathrm{RW}^1} \\ \lambda^{\mathrm{RW}^2} \\ U \end{array} \begin{array}{c} \begin{array}{c} \epsilon^{\pi} \end{array} \\ \begin{pmatrix} -3.8839 \\ 0.5193 \\ -0.3361 \end{pmatrix} \end{array}$$

8 Model statistics

8.1 Basic statistics

	Steady-state value	Std. dev.	Variance	Loglin
$etaqpi$	1	0.1303	0.017	Y
i	0	0.7719	0.5958	N
λ^{RW^1}	-0.683	0.4292	0.1842	Y
λ^{RW^2}	0	0.0501	0.0025	N
π	0	0.0985	0.0097	N
y	-4.0568	0.1707	0.0292	Y
U	-33.8066	0.0448	0.002	Y

8.2 Correlation matrix

	etaqpi	i	λ^{RW^1}	λ^{RW^2}	π	y	U
etaqpi	1	-0.301	-0.825	0.436	-0.491	-0.7	-0.999
i		1	0.567	-0.977	-0.323	-0.443	0.28
λ^{RW^1}			1	-0.725	0.567	0.44	0.832
λ^{RW^2}				1	0.116	0.273	-0.421
π					1	0.826	0.524
y						1	0.721
U							1

8.3 Cross correlations with the reference variable (i)

	$\sigma[\cdot]$ rel. to $\sigma[i]$	i_{t-5}	i_{t-4}	i_{t-3}	i_{t-2}	i_{t-1}	i_t	i_{t+1}	i_{t+2}	i_{t+3}	i_{t+4}	i_{t+5}
$etaqpi_t$	0.169	0.098	0.131	0.177	0.258	0.444	-0.301	-0.254	-0.21	-0.169	-0.132	-0.099
i_t	1	-0.028	-0.035	-0.051	-0.093	-0.219	1	-0.219	-0.093	-0.051	-0.035	-0.028
$\lambda_t^{\mathrm{RW}^1}$	0.556	-0.078	-0.1	-0.134	-0.204	-0.385	0.567	0.47	0.151	0.043	0.003	-0.013
$\lambda_t^{\mathrm{RW}^2}$	0.065	0.04	0.051	0.071	0.122	0.269	-0.977	0.043	0.043	0.041	0.038	0.035
π_t	0.128	-0.046	-0.056	-0.071	-0.096	-0.156	-0.323	0.852	0.236	0.04	-0.022	-0.04
y_t	0.221	-0.069	-0.092	-0.121	-0.164	-0.245	-0.443	0.551	0.273	0.164	0.111	0.078
U_t	0.058	-0.098	-0.13	-0.176	-0.257	-0.441	0.28	0.286	0.215	0.167	0.128	0.095

8.4 Autocorrelations

	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5
etaqpi	0.713	0.471	0.271	0.11	-0.016
i	-0.219	-0.093	-0.051	-0.035	-0.028
λ^{RW^1}	0.51	0.081	-0.065	-0.117	-0.134
λ^{RW^2}	-0.074	-0.071	-0.066	-0.06	-0.054
π	0.22	-0.024	-0.095	-0.11	-0.107
y	0.504	0.261	0.116	0.017	-0.055
U	0.725	0.459	0.256	0.097	-0.025

9 Impulse response functions

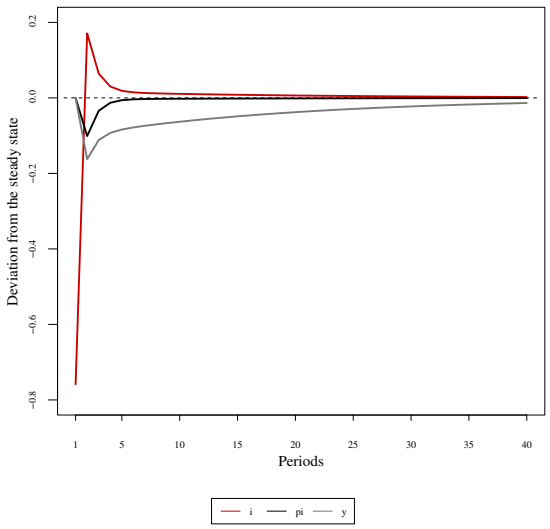

Figure 1: Impulse responses (i, π, y) to ϵ^{π} shock