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Model name: `RSW`

1 HIGHREGIME

1.1 Optimisation problem

$$\max_{piH_t, yH_t, iH_t} UH_t = -0.5 piH_t^2 + \beta \left(pH \mathrm{E}_t \left[UH_{t+1} \right] + (1 - pH) \mathrm{E}_t \left[UL_{t+1} \right] \right) - 0.5 \kappa \theta^{-1} yH_t^2 \tag{1.1}$$

s.t. :

$$piH_{t-1} = \beta \left(pH piH_t + piL_t (1 - pH) \right) + \kappa yH_{t-1} \quad \left(\lambda_t^{\mathrm{HIGHREGIME}^1} \right) \tag{1.2}$$

$$yH_{t-1} = pH yH_t + yL_t (1 - pH) - \sigma \left(iH_{t-1} - m_{t-1} - pH piH_t - piL_t (1 - pH) \right) \quad \left(\lambda_t^{\mathrm{HIGHREGIME}^2} \right) \tag{1.3}$$

1.2 First order conditions

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

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

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

2 LOWREGIME

2.1 Optimisation problem

$$\max_{piL_t, yL_t, iL_t} UL_t = -0.5 piL_t^2 + \beta \left(pL \mathrm{E}_t \left[UL_{t+1} \right] + (1 - pL) \mathrm{E}_t \left[UH_{t+1} \right] \right) - 0.5 \kappa \theta^{-1} yL_t^2 \tag{2.1}$$

s.t. :

$$piL_{t-1} = \beta \left(pL piL_t + piH_t (1 - pL) \right) + \kappa yL_{t-1} \quad \left(\lambda_t^{\mathrm{LOWREGIME}^1} \right) \tag{2.2}$$

$$yL_{t-1} = pL yL_t + yH_t (1 - pL) - \sigma \left(iL_{t-1} - m_{t-1} - pL piL_t - piH_t (1 - pL) \right) \quad \left(\lambda_t^{\mathrm{LOWREGIME}^2} \right) \tag{2.3}$$

2.2 First order conditions

$$-piL_t + \beta pL \lambda_t^{\mathrm{LOWREGIME}^1} - \beta pL \mathrm{E}_t \left[\lambda_{t+1}^{\mathrm{LOWREGIME}^1} \right] + pL \sigma \lambda_t^{\mathrm{LOWREGIME}^2} = 0 \quad (piL_t) \tag{2.4}$$

$$pL\lambda_t^{\mathrm{LOWREGIME}^2} + \beta pL\left(\kappa \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{LOWREGIME}^1}\right] - \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{LOWREGIME}^2}\right]\right) - \kappa\theta^{-1} yL_t = 0 \quad (yL_t) \tag{2.5}$$

$$-\beta pL\sigma \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{LOWREGIME}^2}\right] = 0 \quad (iL_t) \tag{2.6}$$

3 EXOG

3.1 Identities

$$m_t = e^{\epsilon_t^Z + \phi \log m_{t-1}} \tag{3.1}$$

4 Equilibrium relationships (after reduction)

$$-m_t + e^{\epsilon_t^Z + \phi \log m_{t-1}} = 0 \tag{4.1}$$

$$-piH_{t-1} + \beta\left(pH piH_t + piL_t\left(1 - pH\right)\right) + \kappa yH_{t-1} = 0 \tag{4.2}$$

$$-piL_{t-1} + \beta\left(pL piL_t + piH_t\left(1 - pL\right)\right) + \kappa yL_{t-1} = 0 \tag{4.3}$$

$$pH\lambda_t^{\mathrm{HIGHREGIME}^2} + \beta pH\left(\kappa \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{HIGHREGIME}^1}\right] - \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{HIGHREGIME}^2}\right]\right) - \kappa\theta^{-1} yH_t = 0 \tag{4.4}$$

$$pL\lambda_t^{\mathrm{LOWREGIME}^2} + \beta pL\left(\kappa \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{LOWREGIME}^1}\right] - \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{LOWREGIME}^2}\right]\right) - \kappa\theta^{-1} yL_t = 0 \tag{4.5}$$

$$-yH_{t-1} + pH yH_t - \sigma\left(iH_{t-1} - m_{t-1} - pH piH_t - piL_t\left(1 - pH\right)\right) + yL_t\left(1 - pH\right) = 0 \tag{4.6}$$

$$-yL_{t-1} + pL yL_t - \sigma\left(iL_{t-1} - m_{t-1} - pL piL_t - piH_t\left(1 - pL\right)\right) + yH_t\left(1 - pL\right) = 0 \tag{4.7}$$

$$-piH_t + \beta pH\lambda_t^{\mathrm{HIGHREGIME}^1} - \beta pH \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{HIGHREGIME}^1}\right] + pH\sigma\lambda_t^{\mathrm{HIGHREGIME}^2} = 0 \tag{4.8}$$

$$-piL_t + \beta pL\lambda_t^{\mathrm{LOWREGIME}^1} - \beta pL \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{LOWREGIME}^1}\right] + pL\sigma\lambda_t^{\mathrm{LOWREGIME}^2} = 0 \tag{4.9}$$

$$UH_t + 0.5 {piH_t}^2 - \beta\left(pH \mathrm{E}_t\left[UH_{t+1}\right] + \left(1 - pH\right)\mathrm{E}_t\left[UL_{t+1}\right]\right) + 0.5\kappa\theta^{-1}{yH_t}^2 = 0 \tag{4.10}$$

$$UL_t + 0.5 {piL_t}^2 - \beta\left(pL \mathrm{E}_t\left[UL_{t+1}\right] + \left(1 - pL\right)\mathrm{E}_t\left[UH_{t+1}\right]\right) + 0.5\kappa\theta^{-1}{yL_t}^2 = 0 \tag{4.11}$$

$$-\beta pH\sigma \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{HIGHREGIME}^2}\right] = 0 \tag{4.12}$$

$$-\beta pL\sigma \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{LOWREGIME}^2}\right] = 0 \tag{4.13}$$

5 Steady state relationships (after reduction)

$$-m_{\mathrm{ss}} + e^{\phi \log m_{\mathrm{ss}}} = 0 \tag{5.1}$$

$$-piH_{\mathrm{ss}} + \beta \left(pHpiH_{\mathrm{ss}} + piL_{\mathrm{ss}} \left(1 - pH\right)\right) + \kappa yH_{\mathrm{ss}} = 0 \tag{5.2}$$

$$-piL_{\mathrm{ss}} + \beta \left(pLpiL_{\mathrm{ss}} + piH_{\mathrm{ss}} \left(1 - pL\right)\right) + \kappa yL_{\mathrm{ss}} = 0 \tag{5.3}$$

$$pH\lambda_{\mathrm{ss}}^{\mathrm{HIGHREGIME}^2} + \beta pH \left(-\lambda_{\mathrm{ss}}^{\mathrm{HIGHREGIME}^2} + \kappa\lambda_{\mathrm{ss}}^{\mathrm{HIGHREGIME}^1}\right) - \kappa\theta^{-1} yH_{\mathrm{ss}} = 0 \tag{5.4}$$

$$pL\lambda_{\mathrm{ss}}^{\mathrm{LOWREGIME}^2} + \beta pL \left(-\lambda_{\mathrm{ss}}^{\mathrm{LOWREGIME}^2} + \kappa\lambda_{\mathrm{ss}}^{\mathrm{LOWREGIME}^1}\right) - \kappa\theta^{-1} yL_{\mathrm{ss}} = 0 \tag{5.5}$$

$$-yH_{\mathrm{ss}} + pHyH_{\mathrm{ss}} - \sigma \left(iH_{\mathrm{ss}} - m_{\mathrm{ss}} - pHpiH_{\mathrm{ss}} - piL_{\mathrm{ss}} \left(1 - pH\right)\right) + yL_{\mathrm{ss}} \left(1 - pH\right) = 0 \tag{5.6}$$

$$-yL_{\mathrm{ss}} + pLyL_{\mathrm{ss}} - \sigma \left(iL_{\mathrm{ss}} - m_{\mathrm{ss}} - pLpiL_{\mathrm{ss}} - piH_{\mathrm{ss}} \left(1 - pL\right)\right) + yH_{\mathrm{ss}} \left(1 - pL\right) = 0 \tag{5.7}$$

$$-piH_{\mathrm{ss}} + pH\sigma\lambda_{\mathrm{ss}}^{\mathrm{HIGHREGIME}^2} = 0 \tag{5.8}$$

$$-piL_{\mathrm{ss}} + pL\sigma\lambda_{\mathrm{ss}}^{\mathrm{LOWREGIME}^2} = 0 \tag{5.9}$$

$$UH_{\mathrm{ss}} + 0.5 piH_{\mathrm{ss}}{}^2 - \beta \left(pHUH_{\mathrm{ss}} + UL_{\mathrm{ss}} \left(1 - pH\right)\right) + 0.5\kappa\theta^{-1} yH_{\mathrm{ss}}{}^2 = 0 \tag{5.10}$$

$$UL_{\mathrm{ss}} + 0.5 piL_{\mathrm{ss}}{}^2 - \beta \left(pLUL_{\mathrm{ss}} + UH_{\mathrm{ss}} \left(1 - pL\right)\right) + 0.5\kappa\theta^{-1} yL_{\mathrm{ss}}{}^2 = 0 \tag{5.11}$$

$$-\beta pH\sigma\lambda_{\mathrm{ss}}^{\mathrm{HIGHREGIME}^2} = 0 \tag{5.12}$$

$$-\beta pL\sigma\lambda_{\mathrm{ss}}^{\mathrm{LOWREGIME}^2} = 0 \tag{5.13}$$

6 Parameter settings

$$\beta = 0.99 \tag{6.1}$$

$$\kappa = 0.2465 \tag{6.2}$$

$$\phi = 0.95 \tag{6.3}$$

$$pH = 0.99 \tag{6.4}$$

$$pL = 0.99 \tag{6.5}$$

$$\sigma = 1 \tag{6.6}$$

$$\theta = 6 \tag{6.7}$$

7 Steady-state values

	Steady-state value
iH	1
iL	1
$\lambda^{\text{HIGHREGIME}^1}$	0
$\lambda^{\text{HIGHREGIME}^2}$	0
$\lambda^{\text{LOWREGIME}^1}$	0
$\lambda^{\text{LOWREGIME}^2}$	0
piH	0
piL	0
m	1
yH	0
yL	0
UH	0
UL	0

8 The solution of the 1st order perturbation

Matrix P

$$\begin{array}{c} \\ iH_t \\ iL_t \\ piH_t \\ piL_t \\ m_t \\ yH_t \\ yL_t \end{array}
\begin{array}{c}
\begin{array}{ccccccc} iH_{t-1} & iL_{t-1} & piH_{t-1} & piL_{t-1} & m_{t-1} & yH_{t-1} & yL_{t-1} \end{array} \\
\begin{pmatrix}
-1.9645 & 0.0223 & 5.8945 & -0.0721 & 2.8922 & -3.4174 & 0.0401 \\
0.0223 & -1.9645 & -0.0721 & 5.8945 & 2.8922 & 0.0401 & -3.4174 \\
0 & 0 & 1.0204 & -0.0103 & 0 & -0.2515 & 0.0025 \\
0 & 0 & -0.0103 & 1.0204 & 0 & 0.0025 & -0.2515 \\
0 & 0 & 0 & 0 & 0.95 & 0 & 0 \\
1.0102 & -0.0102 & -1.0204 & 0.0103 & -1 & 1.2617 & -0.0127 \\
-0.0102 & 1.0102 & 0.0103 & -1.0204 & -1 & -0.0127 & 1.2617
\end{pmatrix}
\end{array}$$

Matrix Q

$$\begin{array}{c} \\ iH \\ iL \\ piH \\ piL \\ m \\ yH \\ yL \end{array}
\begin{array}{c}
\epsilon^{\mathrm{Z}} \\
\begin{pmatrix} 1 \\ 1 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{pmatrix}
\end{array}$$

Matrix R

$$\begin{array}{c} \\ \lambda_t^{\text{HIGHREGIME}^1} \\ \lambda_t^{\text{HIGHREGIME}^2} \\ \lambda_t^{\text{LOWREGIME}^1} \\ \lambda_t^{\text{LOWREGIME}^2} \\ UH_t \\ UL_t \end{array}
\begin{array}{c}
\begin{array}{ccccccc} iH_{t-1} & iL_{t-1} & piH_{t-1} & piL_{t-1} & m_{t-1} & yH_{t-1} & yL_{t-1} \end{array} \\
\begin{pmatrix}
-0.516 & 0.0105 & 3.5035 & -0.0625 & 0.5055 & -1.3796 & 0.0259 \\
0.1347 & -0.0024 & -0.516 & 0.0105 & -0.1323 & 0.2619 & -0.005 \\
0.0105 & -0.516 & -0.0625 & 3.5035 & 0.5055 & 0.0259 & -1.3796 \\
-0.0024 & 0.1347 & 0.0105 & -0.516 & -0.1323 & -0.005 & 0.2619 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}
\end{array}$$

Matrix S

$$\begin{array}{l} \\ \lambda^{\text{HIGHREGIME}^1} \\ \lambda^{\text{HIGHREGIME}^2} \\ \lambda^{\text{LOWREGIME}^1} \\ \lambda^{\text{LOWREGIME}^2} \\ UH \\ UL \end{array} \begin{array}{c} \epsilon^{\text{Z}} \\ \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \end{array}$$

9 Model statistics

9.1 Basic statistics

	Steady-state value	Std. dev.	Variance	Loglin
iH	1	0.1303	0.017	Y
iL	1	0.1303	0.017	Y
$\lambda^{\text{HIGHREGIME}^1}$	0	0	0	N
$\lambda^{\text{HIGHREGIME}^2}$	0	0	0	N
$\lambda^{\text{LOWREGIME}^1}$	0	0	0	N
$\lambda^{\text{LOWREGIME}^2}$	0	0	0	N
piH	0	0	0	N
piL	0	0	0	N
m	1	0.1303	0.017	Y
yH	0	0	0	N
yL	0	0	0	N
UH	0	0	0	N
UL	0	0	0	N

9.2 Correlation matrix

	iH	iL	m
iH	1	1	1
iL		1	1
m			1

9.3 Cross correlations with the reference variable (iH)

	$\sigma[\cdot]$ rel. to $\sigma[iH]$	iH_{t-5}	iH_{t-4}	iH_{t-3}	iH_{t-2}	iH_{t-1}	iH_t	iH_{t+1}	iH_{t+2}	iH_{t+3}	iH_{t+4}	iH_{t+5}
iH_t	1	-0.016	0.11	0.271	0.471	0.713	1	0.713	0.471	0.271	0.11	-0.016
iL_t	1	-0.016	0.11	0.271	0.471	0.713	1	0.713	0.471	0.271	0.11	-0.016
m_t	1	-0.016	0.11	0.271	0.471	0.713	1	0.713	0.471	0.271	0.11	-0.016

9.4 Autocorrelations

	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5
iH	0.713	0.471	0.271	0.11	-0.016
iL	0.713	0.471	0.271	0.11	-0.016
m	0.713	0.471	0.271	0.11	-0.016

10 Impulse response functions

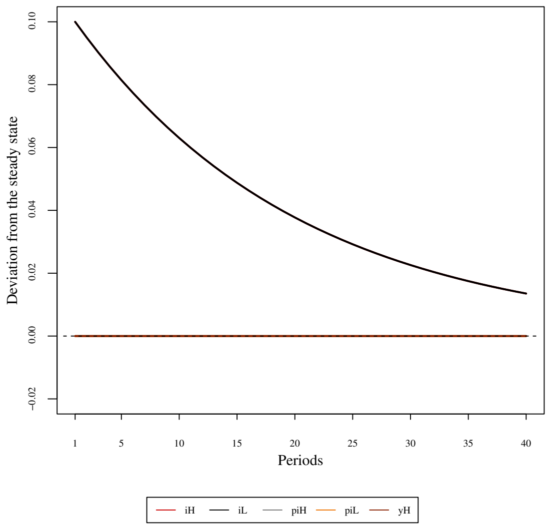

Figure 1: Impulse responses (iH, iL, piH, piL, yH) to ϵ^{Z} shock

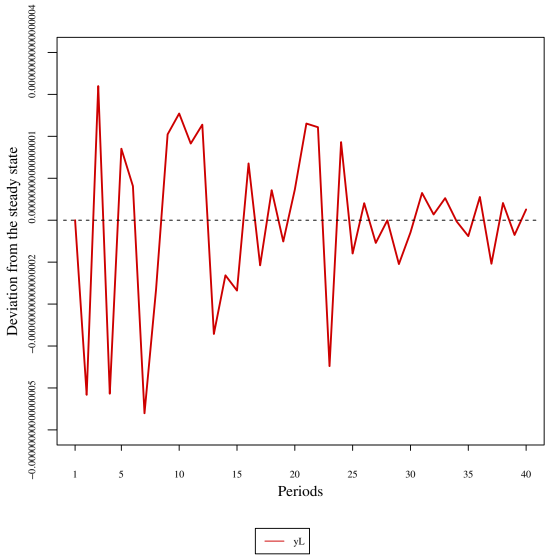

Figure 2: Impulse response (yL) to ϵ^{Z} shock