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Model name: RSW_RP_ONEOBJ

1 OPTIMALMP

1.1 Optimisation problem

$$\max_{piH_t, yH_t, i_t, piL_t, yL_t} U_t = -0.25\left(pitH - pitCB + piH_t\right)^2 - 0.25\left(-pitCB + pitL + piL_t\right)^2 + \beta \mathrm{E}_t\left[U_{t+1}\right] - 0.25\kappa\theta^{-1} {yH_t}^2 - 0.25\kappa\theta^{-1} {yL_t}^2 \tag{1.1}$$

s.t. :

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

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

$$piL_{t-1} = \log etapi_{t-1} + \kappa yL_{t-1} + \beta pL piL_t + \beta\left(1 - pL\right)\left(piH_t - piL_t\right) \quad \left(\lambda_t^{\mathrm{OPTIMALMP}^3}\right) \tag{1.4}$$

$$yL_{t-1} = yL_t - \sigma\left(i_{t-1} - piL_t\right) + \left(1 - pL\right)\left(yH_t - yL_t\right) + \sigma\left(1 - pL\right)\left(piH_t - piL_t\right) \quad \left(\lambda_t^{\mathrm{OPTIMALMP}^4}\right) \tag{1.5}$$

1.2 First order conditions

$$-0.5pitH + 0.5pitCB - 0.5piH_t - \beta \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^1}\right] + \lambda_t^{\mathrm{OPTIMALMP}^1}\left(\beta - \beta\left(1 - pH\right)\right) + \lambda_t^{\mathrm{OPTIMALMP}^2}\left(\sigma - \sigma\left(1 - pH\right)\right) + \beta\lambda_t^{\mathrm{OPTIMALMP}^3}\left(1 - pL\right) + \sigma\lambda_t^{\mathrm{OPTIMALMP}^4}\left(1 - pL\right) = 0 \quad (piH_t) \tag{1.6}$$

$$\beta\left(\kappa \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^1}\right] - \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^2}\right]\right) + pH\lambda_t^{\mathrm{OPTIMALMP}^2} + \lambda_t^{\mathrm{OPTIMALMP}^4}\left(1 - pL\right) - 0.5\kappa\theta^{-1} yH_t = 0 \quad (yH_t) \tag{1.7}$$

$$\beta\left(-\sigma \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^2}\right] - \sigma \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^4}\right]\right) = 0 \quad (i_t) \tag{1.8}$$

$$0.5pitCB - 0.5pitL - 0.5piL_t - \beta \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^3}\right] + \lambda_t^{\mathrm{OPTIMALMP}^3}\left(\beta pL - \beta\left(1 - pL\right)\right) + \lambda_t^{\mathrm{OPTIMALMP}^4}\left(\sigma - \sigma\left(1 - pL\right)\right) + \beta\lambda_t^{\mathrm{OPTIMALMP}^1}\left(1 - pH\right) + \sigma\lambda_t^{\mathrm{OPTIMALMP}^2}\left(1 - pH\right) = 0 \quad (piL_t) \tag{1.9}$$

$$\beta\left(\kappa \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^3}\right] - \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^4}\right]\right) + pL\lambda_t^{\mathrm{OPTIMALMP}^4} + \lambda_t^{\mathrm{OPTIMALMP}^2}\left(1 - pH\right) - 0.5\kappa\theta^{-1} yL_t = 0 \quad (yL_t) \tag{1.10}$$

2 EXOG

2.1 Identities

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

3 Equilibrium relationships (after reduction)

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

$$\beta\left(\kappa \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^1}\right] - \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^2}\right]\right) + pH\lambda_t^{\mathrm{OPTIMALMP}^2} + \lambda_t^{\mathrm{OPTIMALMP}^4}(1-pL) - 0.5\kappa\theta^{-1}yH_t = 0 \tag{3.2}$$

$$\beta\left(\kappa \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^3}\right] - \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^4}\right]\right) + pL\lambda_t^{\mathrm{OPTIMALMP}^4} + \lambda_t^{\mathrm{OPTIMALMP}^2}(1-pH) - 0.5\kappa\theta^{-1}yL_t = 0 \tag{3.3}$$

$$-piH_{t-1} + \log etapi_{t-1} + \beta piH_t + \kappa yH_{t-1} + \beta(1-pH)(-piH_t + piL_t) = 0 \tag{3.4}$$

$$-piL_{t-1} + \log etapi_{t-1} + \kappa yL_{t-1} + \beta pLpiL_t + \beta(1-pL)(piH_t - piL_t) = 0 \tag{3.5}$$

$$-yH_{t-1} + yH_t - \sigma(i_{t-1} - piH_t) + (1-pH)(-yH_t + yL_t) + \sigma(1-pH)(-piH_t + piL_t) = 0 \tag{3.6}$$

$$-yL_{t-1} + yL_t - \sigma(i_{t-1} - piL_t) + (1-pL)(yH_t - yL_t) + \sigma(1-pL)(piH_t - piL_t) = 0 \tag{3.7}$$

$$U_t + 0.25(pitH - pitCB + piH_t)^2 + 0.25(-pitCB + pitL + piL_t)^2 - \beta \mathrm{E}_t[U_{t+1}] + 0.25\kappa\theta^{-1}yH_t{}^2 + 0.25\kappa\theta^{-1}yL_t{}^2 = 0 \tag{3.8}$$

$$-0.5pitH + 0.5pitCB - 0.5piH_t - \beta \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^1}\right] + \lambda_t^{\mathrm{OPTIMALMP}^1}(\beta - \beta(1-pH)) + \lambda_t^{\mathrm{OPTIMALMP}^2}(\sigma - \sigma(1-pH)) + \beta\lambda_t^{\mathrm{OPTIMALMP}^3}(1-pL) + \sigma\lambda_t^{\mathrm{OPTIMALMP}^4}(1-pL) = 0 \tag{3.9}$$

$$0.5pitCB - 0.5pitL - 0.5piL_t - \beta \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^3}\right] + \lambda_t^{\mathrm{OPTIMALMP}^3}(\beta pL - \beta(1-pL)) + \lambda_t^{\mathrm{OPTIMALMP}^4}(\sigma - \sigma(1-pL)) + \beta\lambda_t^{\mathrm{OPTIMALMP}^1}(1-pH) + \sigma\lambda_t^{\mathrm{OPTIMALMP}^2}(1-pH) = 0 \tag{3.10}$$

$$\beta\left(-\sigma \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^2}\right] - \sigma \mathrm{E}_t\left[\lambda_{t+1}^{\mathrm{OPTIMALMP}^4}\right]\right) = 0 \tag{3.11}$$

4 Steady state relationships (after reduction)

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

$$\beta\left(-\lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^2} + \kappa\lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^1}\right) + pH\lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^2} + \lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^4}(1-pL) - 0.5\kappa\theta^{-1}yH_{\mathrm{ss}} = 0 \tag{4.2}$$

$$\beta\left(-\lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^4} + \kappa\lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^3}\right) + pL\lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^4} + \lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^2}(1-pH) - 0.5\kappa\theta^{-1}yL_{\mathrm{ss}} = 0 \tag{4.3}$$

$$-piH_{\mathrm{ss}} + \log etapi_{\mathrm{ss}} + \beta piH_{\mathrm{ss}} + \kappa yH_{\mathrm{ss}} + \beta(1-pH)(-piH_{\mathrm{ss}} + piL_{\mathrm{ss}}) = 0 \tag{4.4}$$

$$-piL_{\mathrm{ss}} + \log etapi_{\mathrm{ss}} + \kappa yL_{\mathrm{ss}} + \beta pLpiL_{\mathrm{ss}} + \beta(1-pL)(piH_{\mathrm{ss}} - piL_{\mathrm{ss}}) = 0 \tag{4.5}$$

$$(1-pH)(-yH_{\mathrm{ss}} + yL_{\mathrm{ss}}) - \sigma(i_{\mathrm{ss}} - piH_{\mathrm{ss}}) + \sigma(1-pH)(-piH_{\mathrm{ss}} + piL_{\mathrm{ss}}) = 0 \tag{4.6}$$

$$(1-pL)(yH_{\mathrm{ss}} - yL_{\mathrm{ss}}) - \sigma(i_{\mathrm{ss}} - piL_{\mathrm{ss}}) + \sigma(1-pL)(piH_{\mathrm{ss}} - piL_{\mathrm{ss}}) = 0 \tag{4.7}$$

$$U_{\mathrm{ss}} + 0.25(pitH - pitCB + piH_{\mathrm{ss}})^2 + 0.25(-pitCB + pitL + piL_{\mathrm{ss}})^2 - \beta U_{\mathrm{ss}} + 0.25\kappa\theta^{-1}yH_{\mathrm{ss}}{}^2 + 0.25\kappa\theta^{-1}yL_{\mathrm{ss}}{}^2 = 0 \tag{4.8}$$

$$-0.5pitH + 0.5pitCB - 0.5piH_{\mathrm{ss}} - \beta\lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^1} + \lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^1}(\beta - \beta(1-pH)) + \lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^2}(\sigma - \sigma(1-pH)) + \beta\lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^3}(1-pL) + \sigma\lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^4}(1-pL) = 0 \tag{4.9}$$

$$0.5pitCB - 0.5pitL - 0.5piL_{\mathrm{ss}} - \beta\lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^3} + \lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^3}(\beta pL - \beta(1-pL)) + \lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^4}(\sigma - \sigma(1-pL)) + \beta\lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^1}(1-pH) + \sigma\lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^2}(1-pH) = 0 \tag{4.10}$$

$$\beta\left(-\sigma\lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^2} - \sigma\lambda_{\mathrm{ss}}^{\mathrm{OPTIMALMP}^4}\right) = 0 \tag{4.11}$$

5 Parameter settings

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

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

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

$$pitH = 2 \tag{5.4}$$

$$pitCB = 2 \tag{5.5}$$

$$pitL = 4 \tag{5.6}$$

$$pH = 0.99 \tag{5.7}$$

$$pL = 0.99 \tag{5.8}$$

$$\sigma = 1 \tag{5.9}$$

$$\theta = 6 \tag{5.10}$$

6 Steady-state values

	Steady-state value
etapi	1
i	-1.0001
$\lambda^{\text{OPTIMALMP}^1}$	-0.0243
$\lambda^{\text{OPTIMALMP}^2}$	-0.5105
$\lambda^{\text{OPTIMALMP}^3}$	0.0141
$\lambda^{\text{OPTIMALMP}^4}$	0.5105
piH	-0.9997
piL	-1.0006
yH	-0.0405
yL	-0.0808
U	-49.9673

7 The solution of the 1st order perturbation

Matrix P

$$\begin{array}{c} \\ etapi_t \\ i_t \\ piH_t \\ piL_t \\ yH_t \\ yL_t \end{array} \begin{array}{c} \begin{array}{cccccc} etapi_{t-1} & i_{t-1} & piH_{t-1} & piL_{t-1} & yH_{t-1} & yL_{t-1} \end{array} \\ \begin{pmatrix} 0.95 & 0 & 0 & 0 & 0 & 0 \\ -29.0023 & -3.0336 & -589.7847 & 607.7495 & 15.026 & -30.556 \\ -1.0103 & 0 & 1.0204 & -0.0104 & -0.0102 & 0.0002 \\ -1.0198 & 0 & -0.0104 & 1.0308 & 0.0001 & -0.0205 \\ 24.9235 & 24.6802 & -25.1736 & 0.2571 & 1.2617 & -0.0255 \\ 12.6276 & 12.3768 & 0.1288 & -12.7635 & -0.0064 & 1.2643 \end{pmatrix} \end{array}$$

Matrix Q

$$\begin{array}{c} \\ etapi \\ i \\ piH \\ piL \\ yH \\ yL \end{array} \begin{array}{c} \begin{array}{c} \epsilon^{\pi} \end{array} \\ \begin{pmatrix} 1 \\ -12.1391 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \end{array}$$

Matrix R

$$\begin{array}{c} \\ \lambda_t^{\text{OPTIMALMP}^1} \\ \lambda_t^{\text{OPTIMALMP}^2} \\ \lambda_t^{\text{OPTIMALMP}^3} \\ \lambda_t^{\text{OPTIMALMP}^4} \\ U_t \end{array} \begin{array}{c} \begin{array}{cccccc} etapi_{t-1} & i_{t-1} & piH_{t-1} & piL_{t-1} & yH_{t-1} & yL_{t-1} \end{array} \\ \begin{pmatrix} 78354.8138 & 5351.9263 & 2931231.873 & -2990881.8819 & -74650.4938 & 150430.5551 \\ -1426.9835 & -97.4423 & -53335.8517 & 54422.0249 & 1358.3293 & -2737.2326 \\ -138117.8358 & -9440.8772 & -5150701.2185 & 5255767.5998 & 131175.5042 & -264343.799 \\ 1435.7948 & 98.1682 & 53590.8208 & -54683.1946 & -1364.8251 & 2750.3637 \\ -0.0034 & 0 & 0.0005 & -0.0003 & 0.0004 & -0.0008 \end{pmatrix} \end{array}$$

Matrix S

$$\begin{array}{c} \\ \lambda^{\text{OPTIMALMP}^1} \\ \lambda^{\text{OPTIMALMP}^2} \\ \lambda^{\text{OPTIMALMP}^3} \\ \lambda^{\text{OPTIMALMP}^4} \\ U \end{array} \begin{array}{c} \begin{array}{c} \epsilon^{\pi} \end{array} \\ \begin{pmatrix} 22259.7763 \\ -405.5204 \\ -39307.9945 \\ 408.4928 \\ -0.0034 \end{pmatrix} \end{array}$$

8 Model statistics

8.1 Basic statistics

	Steady-state value	Std. dev.	Variance	Loglin
etapi	1	0.1303	0.017	Y
i	-1.0001	1.4658	2.1487	Y
$\lambda^{\text{OPTIMALMP}^1}$	-0.0243	2399.9295	5759661.7798	Y
$\lambda^{\text{OPTIMALMP}^2}$	-0.5105	43.7148	1910.9849	Y
$\lambda^{\text{OPTIMALMP}^3}$	0.0141	4228.1871	17877566.0584	Y
$\lambda^{\text{OPTIMALMP}^4}$	0.5105	43.9456	1931.2164	Y
piH	-0.9997	0.1683	0.0283	Y
piL	-1.0006	0.1688	0.0285	Y
yH	-0.0405	25.2506	637.5929	Y
yL	-0.0808	12.6478	159.9677	Y
U	-49.9673	0	0	Y

8.2 Correlation matrix

	etapi	i	$\lambda^{\text{OPTIMALMP}^1}$	$\lambda^{\text{OPTIMALMP}^2}$	$\lambda^{\text{OPTIMALMP}^3}$	$\lambda^{\text{OPTIMALMP}^4}$	*piH*	*piL*	*yH*
etapi	1	-0.099	0.753	-0.753	-0.751	0.751	0.156	0.153	-0.559
i		1	-0.398	0.398	0.402	-0.402	-0.206	-0.209	-0.656
$\lambda^{\text{OPTIMALMP}^1}$			1	-1	-1	1	-0.179	-0.182	-0.385
$\lambda^{\text{OPTIMALMP}^2}$				1	1	-1	0.18	0.183	0.386
$\lambda^{\text{OPTIMALMP}^3}$					1	-1	0.182	0.185	0.382
$\lambda^{\text{OPTIMALMP}^4}$						1	-0.18	-0.183	-0.382
piH							1	1	0.443
piL								1	0.447
yH									1
yL									

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}	
$etapi_t$	0.089	-0.021	-0.008	0.033	0.16	0.562	-0.099	-0.09	-0.08	-0.07	-0.06	-
i_t	1	-0.004	-0.012	-0.035	-0.109	-0.343	1	-0.343	-0.109	-0.035	-0.012	-0
$\lambda_t^{\text{OPTIMALMP}^1}$	1637.229	0	0.015	0.058	0.191	0.61	-0.398	-0.234	-0.135	-0.074	-0.036	-0
$\lambda_t^{\text{OPTIMALMP}^2}$	29.822	0	-0.015	-0.058	-0.191	-0.61	0.398	0.235	0.135	0.073	0.036	0
$\lambda_t^{\text{OPTIMALMP}^3}$	2884.463	0	-0.015	-0.058	-0.191	-0.611	0.402	0.236	0.134	0.072	0.035	0
$\lambda_t^{\text{OPTIMALMP}^4}$	29.98	0	0.015	0.058	0.191	0.611	-0.402	-0.234	-0.134	-0.073	-0.036	-0
piH_t	0.115	-0.007	-0.008	-0.011	-0.024	-0.067	-0.206	0.863	-0.019	-0.179	-0.157	-0
piL_t	0.115	-0.007	-0.008	-0.011	-0.025	-0.068	-0.209	0.863	-0.016	-0.177	-0.156	-0
yH_t	17.226	0.012	0.007	-0.008	-0.055	-0.199	-0.656	0.635	0.147	0.021	-0.004	-0
yL_t	8.628	0.012	0.007	-0.008	-0.055	-0.199	-0.656	0.636	0.147	0.02	-0.004	-0

8.4 Autocorrelations

	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5
etapi	0.713	0.471	0.271	0.11	-0.016
i	-0.343	-0.109	-0.035	-0.012	-0.004
$\lambda^{\text{OPTIMALMP}^1}$	0.467	0.156	-0.021	-0.115	-0.159
$\lambda^{\text{OPTIMALMP}^2}$	0.467	0.154	-0.022	-0.116	-0.159
$\lambda^{\text{OPTIMALMP}^3}$	0.463	0.151	-0.023	-0.116	-0.158
$\lambda^{\text{OPTIMALMP}^4}$	0.464	0.153	-0.022	-0.115	-0.158
piH	0.218	-0.026	-0.098	-0.113	-0.109
piL	0.217	-0.027	-0.098	-0.113	-0.109
yH	0.163	-0.029	-0.055	-0.05	-0.045
yL	0.162	-0.03	-0.056	-0.05	-0.045

9 Impulse response functions

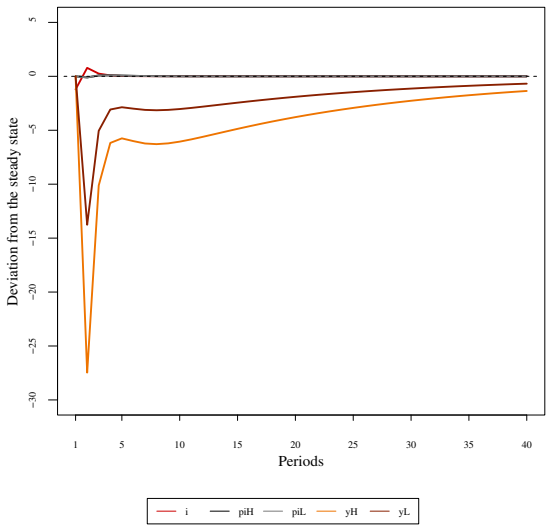

Figure 1: Impulse responses (i, piH, piL, yH, yL) to ϵ^{π} shock