Stock-Flow-Consistent Modeling
Lecture 5: open economy models

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A simple two-region models: Assumptions

(From Godley-Lavoie, 2007, ch.6)

Two regions – single central government, and single Central Bank.

Same currency, so no exchange rate

Financial assets given by HP money and government bonds (no regionally-issued assets)

Can approximate two (blocks of) countries in the Eurozone under a common fiscal policy

The balance sheet

Table 6.1 Balance sheet of two-region economy (Model *REG*)

	North households	South households	Government	Central bank	Σ
Cash money	$+H_h^N$	$+H_h^S$		$-H$	0
Bills	$+B_h^N$	$+B_h^S$	$-B$	$+B_{cb}$	0
Wealth (balancing item)	$-V_h^N$	$-V_h^S$	$-V_g$	0	0
Σ	0	0	0	0	0

Transaction matrix

Table 6.2 Transactions-flow matrix of two-region economy (Model *REG*)

	North households	North production	South households	South production	Government	Central bank	Σ
Consumption	$-C^N$	$+C^N$	$-C^S$	$+C^S$			0
Govt. exp.		$+G^N$		$+G^S$	$-G$		0
North Exports to South		$+X^N$		$-IM^S$			0
South Exports to North		$-IM^N$		$+X^S$			0
GDP	$+Y^N$	$-Y^N$	$+Y^S$	$-Y^S$			0
Interest payments	$+r_{-1} \cdot B^N_{h-1}$		$+r_{-1} \cdot B^S_{h-1}$		$-r_{-1}B_{-1}$	$+r_{-1} \cdot B_{cb-1}$	0
Profits of central bank					$+r_{-1} \cdot B_{cb-1}$	$-r_{-1} \cdot B_{cb-1}$	0
Taxes	$-T^N$		$-T^S$		$+T$		0
Change in cash	$-\Delta H^N_h$		$-\Delta H^S_h$			$+\Delta H$	0
Change in bills	$-\Delta B^N_h$		$-\Delta B^S_h$		$+\Delta B$	$-\Delta B_{cb}$	0
Σ	0	0	0	0	0	0	0

Model equations

$$Y^{N} = C^{N} + G^{N} + X^{N} - IM^{N} \tag{6.1}$$

$$Y^{S} = C^{S} + G^{S} + X^{S} - IM^{S} \tag{6.2}$$

$$IM^{N} = \mu^{N} \cdot Y^{N} \tag{6.3}$$

$$IM^{S} = \mu^{S} \cdot Y^{S} \tag{6.4}$$

$$X^{N} = IM^{S} \tag{6.5}$$

$$X^{S} = IM^{N} \tag{6.6}$$

Model equations #2

$$YD^{\mathrm{N}} = Y^{\mathrm{N}} - T^{\mathrm{N}} + r_{-1} \cdot B^{\mathrm{N}}_{\mathrm{h}-1} \tag{6.7}$$

$$YD^{\mathrm{S}} = Y^{\mathrm{S}} - T^{\mathrm{S}} + r_{-1} \cdot B^{\mathrm{S}}_{\mathrm{h}-1} \tag{6.8}$$

$$T^{\mathrm{N}} = \theta \cdot (Y^{\mathrm{N}} + r_{-1} \cdot B^{\mathrm{N}}_{\mathrm{h}-1}) \quad 0 < \theta < 1 \tag{6.9}$$

$$T^{\mathrm{S}} = \theta \cdot (Y^{\mathrm{S}} + r_{-1} \cdot B^{\mathrm{S}}_{\mathrm{h}-1}) \quad 0 < \theta < 1 \tag{6.10}$$

$$V^{\mathrm{N}} = V^{\mathrm{N}}_{-1} + (YD^{\mathrm{N}} - C^{\mathrm{N}}) \tag{6.11}$$

$$V^{\mathrm{S}} = V^{\mathrm{S}}_{-1} + (YD^{\mathrm{S}} - C^{\mathrm{S}}) \tag{6.12}$$

$$C^{\mathrm{N}} = \alpha^{\mathrm{N}}_{1} \cdot YD^{\mathrm{N}} + \alpha^{\mathrm{N}}_{2} \cdot V^{\mathrm{N}}_{-1} \quad 0 < \alpha_2 < \alpha_1 < 1 \tag{6.13}$$

$$C^{\mathrm{S}} = \alpha^{\mathrm{S}}_{1} \cdot YD^{\mathrm{S}} + \alpha^{\mathrm{S}}_{2} \cdot V^{\mathrm{S}}_{-1} \quad 0 < \alpha_2 < \alpha_1 < 1 \tag{6.14}$$

Model equations #3

$$H_{\mathrm{h}}^{\mathrm{N}} = V^{\mathrm{N}} - B_{\mathrm{h}}^{\mathrm{N}} \tag{6.15}$$

$$H_{\mathrm{h}}^{\mathrm{S}} = V^{\mathrm{S}} - B_{\mathrm{h}}^{\mathrm{S}} \tag{6.16}$$

$$\frac{B_{\mathrm{h}}^{\mathrm{N}}}{V^{\mathrm{N}}} = \lambda_0^{\mathrm{N}} + \lambda_1^{\mathrm{N}} \cdot r - \lambda_2^{\mathrm{N}} \cdot \left(\frac{YD^{\mathrm{N}}}{V^{\mathrm{N}}}\right) \tag{6.17}$$

$$\frac{B_{\mathrm{h}}^{\mathrm{S}}}{V^{\mathrm{S}}} = \lambda_0^{\mathrm{S}} + \lambda_1^{\mathrm{S}} \cdot r - \lambda_2^{\mathrm{S}} \cdot \left(\frac{YD^{\mathrm{S}}}{V^{\mathrm{S}}}\right) \tag{6.18}$$

Model equations #4

$$T = T^{\mathrm{N}} + T^{\mathrm{S}} \tag{6.19}$$

$$G = G^{\mathrm{N}} + G^{\mathrm{S}} \tag{6.20}$$

$$B_{\mathrm{h}} = B_{\mathrm{h}}^{\mathrm{N}} + B_{\mathrm{h}}^{\mathrm{S}} \tag{6.21}$$

$$H_{\mathrm{h}} = H_{\mathrm{h}}^{\mathrm{N}} + H_{\mathrm{h}}^{\mathrm{S}} \tag{6.22}$$

$$\Delta B_{\mathrm{s}} = B_{\mathrm{s}} - B_{\mathrm{s}-1} = (G + r_{-1} \cdot B_{\mathrm{s}-1}) - (T + r_{-1} \cdot B_{\mathrm{cb}-1}) \tag{6.23}$$

$$\Delta H_{\mathrm{s}} = H_{\mathrm{s}} - H_{\mathrm{s}-1} = \Delta B_{\mathrm{cb}} \tag{6.24}$$

$$B_{\mathrm{cb}} = B_{\mathrm{s}} - B_{\mathrm{h}} \tag{6.25}$$

$$r = \bar{r} \tag{6.26}$$

Model equations and steady-state

$H_s = H_h$ ***Missing equation*** (6.27)

$$\Delta V^{N} = Y^{N} + r_{-1} \cdot B^{N}_{-1} - T^{N} - C^{N}$$

$$\Delta V^{N} = (G^{N} + r_{-1} \cdot B^{N}_{-1}) + X^{N} - T^{N} - IM^{N}$$

$$G^{N}_{T} = G^{N} + r_{-1} \cdot B^{N}_{h-1}$$

$$\Delta V^{N} = (G^{N}_{T} + X^{N}) - (T^{N} + IM^{N}) = (G^{N}_{T} - T^{N}) + (X^{N} - IM^{N})$$

Steady state solution

$$G_{\mathrm{T}}^{\mathrm{N}} - T^{\mathrm{N}} = IM^{\mathrm{N}} - X^{\mathrm{N}}$$

$$G_{\mathrm{NT}}^{\mathrm{N}} = G^{\mathrm{N}} + r_{-1} \cdot B_{\mathrm{h}-1}^{\mathrm{N}} - \theta \cdot r_{-1} \cdot B_{\mathrm{h}-1}^{\mathrm{N}}$$

$$Y^{\mathrm{N}*} = \frac{(G_{\mathrm{NT}}^{\mathrm{N}} + X^{\mathrm{N}})}{(\theta + \mu^{\mathrm{N}})}$$

Foreign trade (Harrod) multiplier

Super stationary

$$Y^{\mathrm{N}\,**} = \frac{G_{\mathrm{NT}}^{\mathrm{N}}}{\theta} = \frac{X^{\mathrm{N}}}{\mu^{\mathrm{N}}}$$

Experiments

With Eviews model REG

A simple two-country model

Assumptions

No capital movement

Fixed exchange rate

Current account imbalances cleared by changes in gold reserves at Central banks (approximates changes in reserves in US dollars)

Balance sheet

Table 6.3 Balance sheet matrix of two-country economy (Model *OPEN*)

	North households	North Govt.	North central bank	South households	South Govt.	South central bank	Σ
Cash money	$+H_h^N$		$-H_h^N$	$+H_h^S$		$-H_h^S$	0
Bills	$+B_h^N$	$-B^N$	$+B_{cb}^N$	$+B_h^S$	$-B^S$	$+B_{cb}^S$	0
Gold reserves			$+or^N \cdot p_g^N \cdot xr$			$+or^S \cdot p_g^S$	$or^N \cdot p_g^N \cdot xr + or^S \cdot p_g^S$
Wealth (balancing item)	$-V_h^N$	$-V_g^N$	0	$-V_h^S$	$-V_g^S$	0	$-(or^N \cdot p_g^N \cdot xr + or^S \cdot p_g^S)$
Σ	0	0	0	0	0	0	0

Transaction matrix

Table 6.4 Transactions-flow matrix of two-country economy (Model *OPEN*)

	North country					South country				
	Households	Producers	Govt.	Central bank		Households	Producers	Govt.	Central bank	Σ
Consumption	$-C^{N}$	$+C^{N}$				$-C^{S}$	$+C^{S}$			0
Govt. exp.		$+G^{N}$	$-G^{N}$				$+G^{S}$	$-G^{S}$		0
North Exports to South		$+X^{N}$			$\cdot xr$		$-IM^{S}$			0
South Exports to North		$-IM^{N}$			$\cdot xr$		$+X^{S}$			0
GDP	$+Y^{N}$	$-Y^{N}$				$+Y^{S}$	$-Y^{S}$			0
Interest payments	$+r_{-1} \cdot B^{N}_{h-1}$		$-r_{-1} \cdot B^{N}_{-1}$	$+r_{-1} \cdot B^{N}_{cb}$		$+r_{-1} \cdot B^{S}_{h-1}$		$-r_{-1} \cdot B^{S}_{-1}$	$+r_{-1} \cdot B^{S}_{cb-1}$	0
Profits of central bank			$+r_{-1} \cdot B^{N}_{cb-1}$	$-r_{-1} \cdot B^{N}_{cb-1}$				$+r_{-1} \cdot B^{S}_{cb-1}$	$-r_{-1} \cdot B^{S}_{cb-1}$	0
Taxes	$-T^{N}$		$+T^{N}$			$-T^{S}$		$+T^{S}$		0
Change in cash	$-\Delta H^{N}_{h}$			$+\Delta H^{N}$		$-\Delta H^{S}_{h}$			$+\Delta H^{S}$	0
Change in bills	$-\Delta B^{N}_{h}$		$+\Delta B^{N}$	$-\Delta B^{N}_{cb}$		$-\Delta B^{S}_{h}$		$+\Delta B^{S}$	$-\Delta B^{S}_{cb}$	0
Change in reserves				$-\Delta or^{N} \cdot p^{N}_{g}$	$\cdot xr$				$-\Delta or^{S} \cdot p^{S}_{g}$	0
Σ	0	0	0	0		0	0	0	0	0

Changed equations

$$X^{\mathrm{N}} = \frac{IM^{\mathrm{S}}}{xr}$$

$$X^{\mathrm{S}} = IM^{\mathrm{N}} \cdot xr$$

$$\Delta B_{\mathrm{s}}^{\mathrm{N}} = B_{\mathrm{s}}^{\mathrm{N}} - B_{\mathrm{s}-1}^{\mathrm{N}} = (G^{\mathrm{N}} + r_{-1}^{\mathrm{N}} \cdot B_{\mathrm{s}-1}^{\mathrm{N}}) - (T^{\mathrm{N}} + r_{-1}^{\mathrm{N}} \cdot B_{\mathrm{cb}-1}^{\mathrm{N}})$$

$$\Delta B_{\mathrm{s}}^{\mathrm{S}} = B_{\mathrm{s}}^{\mathrm{S}} - B_{\mathrm{s}-1}^{\mathrm{S}} = (G^{\mathrm{S}} + r_{-1}^{\mathrm{S}} \cdot B_{\mathrm{s}-1}^{\mathrm{S}}) - (T^{\mathrm{S}} + r_{-1}^{\mathrm{S}} \cdot B_{\mathrm{cb}-1}^{\mathrm{S}})$$

$$B_{\mathrm{cb}}^{\mathrm{N}} = B_{\mathrm{s}}^{\mathrm{N}} - B_{\mathrm{h}}^{\mathrm{N}}$$

$$B_{\mathrm{cb}}^{\mathrm{S}} = B_{\mathrm{s}}^{\mathrm{S}} - B_{\mathrm{h}}^{\mathrm{S}}$$

Changed equations #2

$$\Delta or^{N.} \cdot p_g^N = \Delta H_s^N - \Delta B_{cb}^N$$

$$\Delta or^{S.} \cdot p_g^S = \Delta H_s^S - \Delta B_{cb}^S$$

$$H_s^N = H_h^N$$

Supply of cash is endogenous

$$H_s^S = H_h^S$$

$$p_g^N = \bar{p}_g^N$$

$$p_g^S = p_g^N \cdot xr$$

Changed equations #3

$$xr = \overline{xr}$$

$$r^{\mathrm{N}} = \bar{r}^{\mathrm{N}}$$

$$r^{\mathrm{S}} = \bar{r}^{\mathrm{S}}$$

$$\Delta or^{\mathrm{S}} = -\Delta or^{\mathrm{N}}$$

Missing equation

Experiments

With Eviews model OPEN

Alternative closure #1

Government expenditure react to changes in gold reserves

Experiments with Eviews model OPENG

$$G^{N} = G^{N}_{-1} + \varphi^{N} \cdot (\Delta or^{N}_{-1} \cdot p^{N}_{g-1})$$

$$G^{S} = G^{S}_{-1} + \varphi^{S} . (\Delta or^{S}_{-1} \cdot p^{S}_{g-1})$$

Alternative closure #2

Adjustments of interest rates

Experiments with Eviews model OPENM

$$r^{\mathrm{N}} = r^{\mathrm{N}}_{-1} - \varphi^{\mathrm{N}} \cdot (\Delta or^{\mathrm{N}}_{-1} \cdot p^{\mathrm{N}}_{\mathrm{g}-1})$$

$$r^{\mathrm{S}} = r^{\mathrm{S}}_{-1} - \varphi^{\mathrm{S}} \cdot (\Delta or^{\mathrm{S}}_{-1} \cdot p^{\mathrm{S}}_{\mathrm{g}-1})$$

Alternative closure #3

Adjustments of interest rates and propensity to spend

Experiments with Eviews model OPENM3

$$\alpha_1^S = \alpha_{10}^S - \iota^S \cdot r^S$$