Summary Ch 8 — Non-Tradable Goods and the Real Exchange Rate

The MX model overestimates the role of the TOT as a driver of fluctuations. Here we break the assumption that all goods are perfectly traded by introducing Non Tradable goods.

A first consequence is that we start accounting for the Real Exchange Rate. In too simplified models this variable is constant. Here it will fluctuate.

Real Exchange Rate: $$RER_t = \frac{\mathcal{E}_t P_t^*}{P_t} \qquad (1)$$

(Relative price of consumption goods baskets)

$\mathcal{E}_t$: Nominal ER. Price of foreign currency in terms of local currency units.

When RER **increases** the local goods basket becomes relatively expensive. This is denoted as an **depreciation.** Similarly, if the RER **decreases**, we observe an **appreciation**.

Three approaches: **1. TNT** model: endowment framework, **2. SVAR**: Empirical framework, **3. MXN**: SOE-RBC framework with exportable, importable and non-tradable goods.

TNT Model

Endowment Open Economy model, with one fully imported good (not domestically produced), one fully exported good (not domestically consumed), and one non-tradable good.

Households:

$$\max_{c_t^m c_{t_t}^n d_{t+1}} \sum_{t=0}^{\infty} \beta^t u(c_t)$$

s.t.

$$c_t = A(c_t^m, c_t^n),$$

$$c_t^m + p_t^n c_t^n + d_t = \frac{d_{t+1}}{1+r} + \underline{tot_t} y^x + p_t^n y^n$$

$$\lim_{j\to\infty} (1+r)^{-j} d_{t+j} \le 0,$$

Units: importables ($P_t^m = 1$)

y^x, y^n: Constant endowments (n: Non tradable)

$A(\cdot,\cdot)$: Increasing, concave, HD1

d_t: External debt maturing in t

$r>0$ interest rate (constant)

FOCs:

$[c_t^m]$: $$U'(c_t)A_1(c_t^m, c_t^n) = \lambda_t, \qquad (2)$$

$[d_{t+1}]$: $$\lambda_t = \beta(1+r)\lambda_{t+1}, \qquad (3)$$

$[c_t^n]'$: $$p_t^n = \frac{A_2(c_t^m, c_t^n)}{A_1(c_t^m, c_t^n)}, \qquad (4)$$

This condition involves $A_1(c_t^m, c_t^n)$ because $\lambda_t / U'(c_t)$ is replaced from (1) in the original FOC wrt c_t^n

$[TVC]$: $$\lim_{j\to\infty} (1+r)^{-j} d_{t+j} = 0. \qquad (5)$$

Given $A(\cdot,\cdot)$ is HD1, (4) can be rewritten as:

$[c_t^n]''$: $$p_t^n = P\left(\frac{c_t^m}{c_t^n}\right); \quad \text{with } P'(\cdot) > 0. \qquad (6)$$

Intuition: Consumption of NT (Importables) decreases (increases) w/ price of NT goods

Link between RER and relative price of Non-Tradables: there is a one-to-one inverse relationship between the RER and the relative price of non-tradable goods.

This is why paper talk about RER and prices of Non-Tradables as analogous quantities

$$RER = \frac{\mathcal{E}_t P_t^*}{P_t} = \frac{\mathcal{E}_t P_t^* / P_t^m}{P_t / P_t^m} = \frac{P_t^* / P_t^{m*}}{P_t / P_t^m} = \frac{\cancel{P_t^{c*}}}{P_t^c}$$

1: Assumed exogenous, constant (and normalized)

Where the second to last equality uses the LOP assumption ($P_t^m = \mathcal{E}_t P_t^{m*}$)

This result implies the RER can be directly associated to the relative price of consumption goods (P_t^c).

Now we check how P_t^c is linked to P_t^n (and then how RER is linked to P_t^n)

Firms bundling (or producing) C_t by aggregating the sub-baskets C_t^m, C_t^n solve:

$$\max_{C_t^m, C_t^n} P_t^c A(C_t^m, C_t^n) - C_t^m - p_t^n C_t^n$$

FOCs:

$[C_t^m]$: $$P_t^c A_1(C_t^m, C_t^n) = 1$$

$$\Rightarrow A_1(C_t^m, C_t^n) = RER_t$$

given $A_1(\cdot,\cdot)$ is HD0: $$A_1(C_t^m, C_t^n) = A_1\left(\frac{C_t^m}{C_t^n}, 1\right)$$

and by (6): $$= A_1(P^{-1}(P_t^n), 1) = RER_t$$

then: $$RER_t = e(p_t^n), \quad \text{with } e'(\cdot) < 0 \quad \left(\text{or } RER_t \propto \frac{1}{P_t^n}\right)$$

Therefore, if the prices of non-tradable **increase**, the RER **appreciates (decreases)**

Market clearing

Non-tradable goods: $$c_t^n = y_t^n \qquad (8)$$

can only be consumed/produced domestically

Subst. (8) in the HH budget constraint to obtain dynamics of debt (current account):

Resource constraint of tradable sector:

$$c_t^m + d_t = \frac{d_{t+1}}{1+r} + tot_t y^x. \qquad (9)$$

Intertemporal Budget Constaint analysis:

Now assume $\beta = \frac{1}{1+r}$

Then given (3) we have: $\lambda_t = \lambda \ \forall t \Rightarrow C_t^m = C^m$ (this follows bc r is constant here so it cancels out w/ r in β)

Iterate BC forward (to infinity) & use TVC (5): $$c^m = -\frac{r}{1+r} d_0 + \frac{r}{1+r} \sum_{t=0}^{\infty} \frac{tot_t y^x}{(1+r)^t}. \qquad (10)$$

The assumption ($\beta(1+r)=1$) and the FOC wrt C_t^n Also imply: $C_t^n = C^n$

The by (6) we get an expression for the equilibrium RER: $$p^n = P\left(\frac{c^m}{y^n}\right) \qquad (11)$$

$\uparrow p^n \equiv \downarrow RER$ (RER appreciates)

RER appreciates when:

- Supply of non-tradable falls $y_t^n \downarrow$
- Current TOT or supply of tradables increase ($c^m \uparrow, tot_t \uparrow, y^x \uparrow$)
- Future TOT or y^x are expected to grow

Effects of TOT shocks

Temporary shock: tot_0 increases, other tot_t remain unchanged

Effect on RER: $$\left.\frac{\partial p^n}{\partial tot}\right|_{\text{temporary}} = \frac{r}{1+r} \frac{y^x}{y^n} P'\left(\frac{c^m}{y^n}\right) > 0.$$ RER decreases (appreciates)

Increase in relative price of exportables creates an income effect, driving up the demand for all goods. Given the supply of NT is fixed, its price increases to eliminate excess demand.

With higher price NT goods the RER will go down (appreciates).