

PC7: Exchange-rate determination

Exercise #1. Exchange rate and external imbalance

Adapted from Olivier Blanchard, Francesco Giavazzi and Filippa Sa, "The US Current Account and the Dollar," Brookings Papers on Economic Activity, 1 (2005): 1-49.

There are two countries: the US and the rest of the world, with perfect capital mobility:

- E is the US dollar exchange rate with the dollar as the base currency: a higher E expresses dollar appreciation);
- r is the dollar interest rate and r^* is the rest of the world interest rate, both being constant over time;
- F_t is the US net external debt at the end of period t and D_t is the US trade deficit of period t ;
 - W_t is the net wealth of US residents expressed in dollars and W_t^* is the net wealth of rest-of-the-world residents expressed in foreign currency, both at the end of period t .

Let X_t and X_t^* be the total outstanding amount of dollar and foreign-currency denominated assets:

$$(1) \quad W_t = X_t - F_t$$

$$(2) \quad \frac{W_t^*}{E_t} = \frac{X_t^*}{E_t} + F_t$$

Suppose that US residents invest a share $0 < \alpha < 1$ of their wealth in dollar-denominated assets and a share $(1-\alpha)$ in foreign-currency denominated assets. Likewise, rest-of-the-world residents invest a share $0 < \alpha^* < 1$ of their wealth in foreign currency-denominated assets and a share $(1 - \alpha^*)$ in dollar-denominated assets. In addition, we assume that $\alpha + \alpha^* > 1$.

- 1) Express the market-clearing equations for dollar-denominated assets, denoted (XX), and for foreign-currency denominated assets, denoted (XX)*. Check that Walras law holds. Express the exchange rate as a function of X_t , X_t^* and F_t . Explain the impact *ceteris paribus* on the exchange rate of a higher net external debt ; of a higher supply of dollar-denominated assets ; of a higher supply of foreign-currency denominated assets.
- 2) Express F_t as a function of W_t and W_t^* and comment the outcome. Using the expression of F_{t-1} , show that US net external debt accumulation can be written as follows:

$$(BB) \quad F_t = (1+r)F_{t-1} + D_t + (1-\alpha) \left((1+r) - (1+r^*) \frac{E_{t-1}}{E_t} \right) (X_{t-1} - F_{t-1})$$

Interpret all terms entering the equation. Explain the impact of a lower dollar on net external debt.

- 3) Suppose now that the current-account deficit D_t increases with the exchange rate (*i.e.* a dollar appreciation widens the current-account deficit) and with an exogenous variable z_t representing the preference of US consumers for foreign products:

$$D_t = D(E_t, z_t) \quad \text{with: } D_E > 0, D_Z > 0$$

The model now boils down to two equations:

$$(XX) \quad X_t = \alpha(X_t - F_t) + (1 - \alpha^*) \left(\frac{X_t^*}{E_t} + F_t \right)$$

$$(BB) \quad F_t = (1+r)F_{t-1} + D(E_t, z_t) + (1-\alpha) \left((1+r) - (1+r^*) \frac{E_{t-1}}{E_t} \right) (X_{t-1} - F_{t-1})$$

Equation (XX) describes the equilibrium of the foreign exchange market while equation (BB) describes net debt accumulation.

We focus on the steady state where X , X^* , F , and E are constant. We also assume that $r = r^*$. Show that equations (XX) and (BB) both yield a decreasing relationship between the exchange rate and external debt. Plot both relationships in the space (F, E) . We assume here that (XX) is steeper than (BB). Study the impact on external debt and on the exchange rate of:

- a) an unexpected, permanent increase in the preference for foreign products, z ;
 - b) a higher world preference $(1-\alpha^*)$ for dollar-denominated assets.
- 4) Explain the impact of a higher US current-account deficit on the value of the dollar, depending on whether this results from lower US exports (*trade view*) or from a higher world demand for dollar-denominated assets (*financial account view*).

Exercise #2. Income convergence and the exchange rate: the Balassa-Samuelson effect

Consider an economy with two sectors: traded goods and services (T) and non-traded goods and services (N). The share of sector T is α with $0 < \alpha < 1$ while the share of sector N is $1-\alpha$. Let P_i be the price level in each sector ($i = T, N$), π_i the (exogenous) hourly labor productivity and W_i the nominal hourly wage. Corresponding variables in the rest of the world are denoted by a star (P_i^*, π_i^*, W_i^*). We assume that $\alpha^* = \alpha$. Labor is internationally immobile.

1) The production function is: $Y_i = \pi_i L_i$, where Y_i is output (in the rest of the world, $Y_i^* = \pi_i^* L_i^*$). Express the relationship between the price level and wage in each sector under perfect competition.

2) Express the law of one price in the traded sector. We assume that this law is verified. Denoting by S the nominal exchange rate expressed with the domestic currency as the quoted currency (i.e. S rises when the domestic currency *depreciates*), express W_T as a function of W_T^* and comment the outcome.

3) Labor is assumed to move freely across sectors within a given country, so that $W_T = W_N = W$ and $W_T^* = W_N^* = W^*$. Express P_N/SP_N^* as a function of W/SW^* .

4) Express the aggregate price levels P and P^* as functions of prices in both sectors and the nominal exchange rate, then the real exchange rate $Q = P/SP^*$.

5) The country's productivity lags the rest of the world due to the traded sector only ($\pi_T < \pi_T^*$, $\pi_N = \pi_N^*$). Show that the link between the traded sector productivity and the real exchange rate is:

$$Q = \left(\frac{\pi_T}{\pi_T^*} \right)^{1-\alpha}.$$

6) In 2008, according to Eurostat, GDP-per-person in Latvia was half the Eurozone average in purchasing power standard:

- Suppose that the traded sector represents 60% of value added and 40% of employment in Latvia and in the Eurozone. Show that productivity in the traded sector is twice as large in the Eurozone as in Latvia;
- Assuming that productivity in the *non-traded* sector is the same in Latvia and in the Eurozone, express the link between productivity in the *traded* sector and the real exchange rate. If GDP-per-person catches up at a pace of 7% per annum in Latvia, what does this imply for the real exchange rate? Is this consistent with Latvia joining the euro?