4 Lecture 4: Nominal exchange rate determination in the long run

Associate reading: Krugman-Obstfeld chapter 15 p. 373-375, Ch.13 and appendix

$$E_t = RER_t \frac{P_t}{P_t^*} \tag{47}$$

is an identity. It provides a theory of the *nominal* exchange rate once we have a theory of:

- the real exchange rate RER_t
- the aggregate price levels P_t, P_t^*.

The latter is necessary to identify how much of a shock to RER (if any) is passed onto the aggregate price level and how much onto the nominal exchange rate.

Theories of the long run, equilibrium real exchange rate.

1. Relative (or absolute) PPP. Constant equilibrium RER.

   Requires: LOP (up to some positive constant) for tradables and constant P_T/P_N.

   - Arbitrage in tradables equalizes their price (up to some wedge).
   - Substitution in production between tradables and nontradables drives the rest.

2. Equilibrium RER can change because of supply (e.g. Balassa-Samuelson) and demand shocks which affect the relative price of tradables and nontradables.

$$\frac{EP^*}{P} = \frac{EP_T^* \left(P_N^*/P_T^*\right)^{\alpha^*}}{P_T \left(P_N/P_T\right)^{\alpha}} = \frac{\left(P_N^*/P_T^*\right)^{\alpha^*}}{\left(P_N/P_T\right)^{\alpha}} \tag{48}$$

   where the last equality follows from LOP.

- Since price levels are endogenous variables we do not have a theory of the *nominal* exchange rate until we have a **theory of the aggregate price level.**
- Even so, the adjustment to the new equilibrium value of RER is driven by arbitrage in the goods markets (LOP in tradables). This is slow.
- So, at best such theories can shed light on the long run equilibrium value of exchange rates.
- Still
  - useful benchmark
  - useful insight about long run trends

4.1 Monetary model of the exchange rate (quantity theory)

Ingredients:

1. Some version of PPP

$$\frac{EP^*}{P} = K \tag{49}$$

   Normalize K to 1, without loss of generality.

2. Vertical aggregate supply. Output is at its full-employment level $\bar{Y}_t$ (money neutrality).

3. Simple money demand independent of interest rate (quantity theory). In nominal terms,

$$M^d = \frac{P\bar{Y}}{V} \tag{50}$$

   Money demand proportional to (nominal) output. V is the velocity of circulation of money.

Money market equilibrium requires

$$M = \frac{P\bar{Y}}{V} \tag{51}$$

or in logs

$$m = p + \bar{y} - v. \tag{52}$$

or

$$p = m - \bar{y} + v. \tag{53}$$

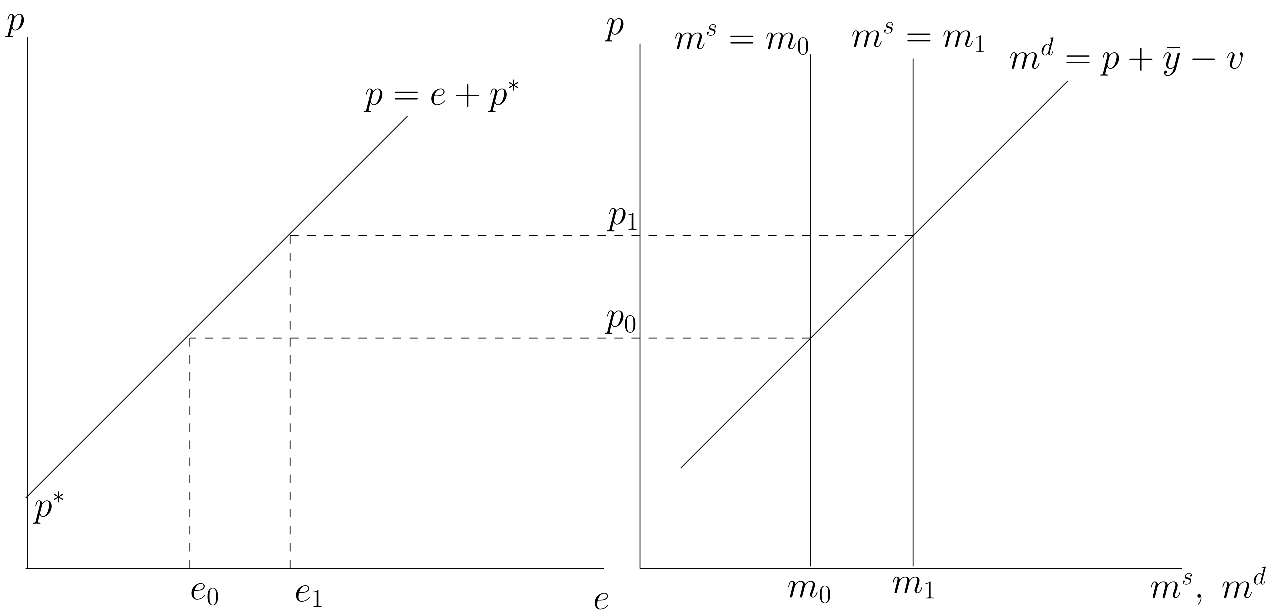
Equation (52) or (53) together with (49) in logs ($K = 1$ implies $\log K = 0$)

$$e = p - p^* \tag{54}$$

form a system of two equations in (p, e).

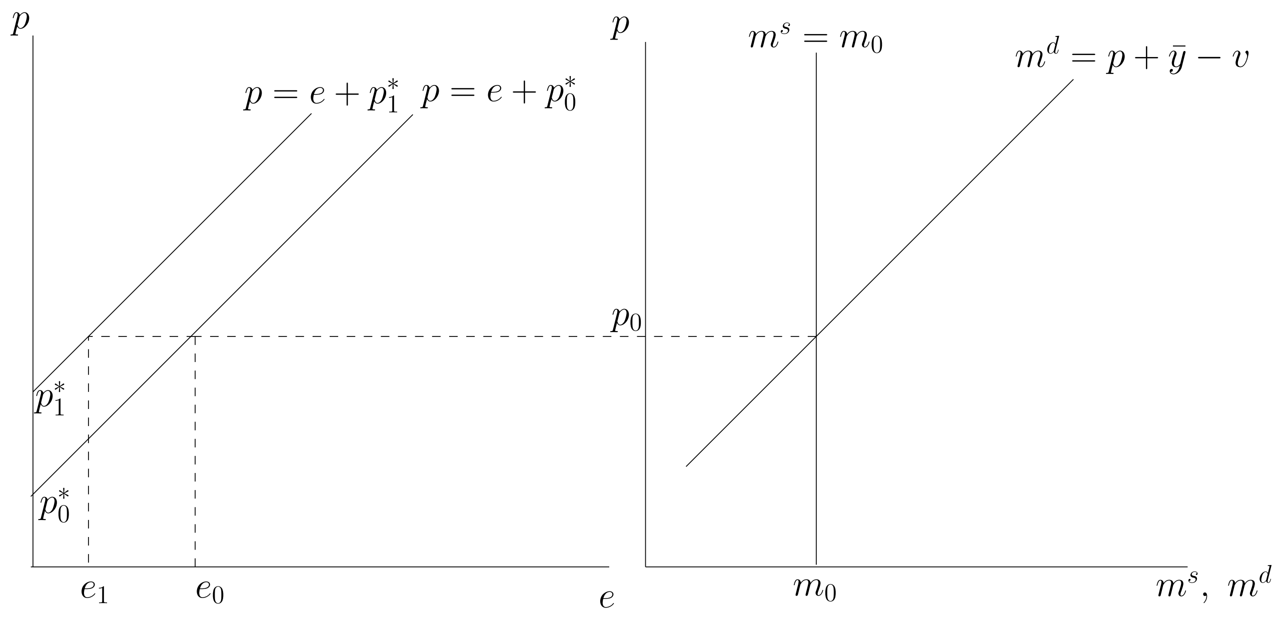
4.1.1 Monetary model (quantity theory) under flexible exchange rate

$$m_1 > m_0$$



- an increase in home money supply relative to money demand ($m \uparrow$ or $y \downarrow$ or $v \uparrow$) results in a nominal depreciation ($e \uparrow$).

$p_1^* > p_0^*$



- If $p^* \uparrow \rightarrow e \downarrow$

Intuition:

- Excess of money supply relative to money demand - $m > p + \bar{y} - v$ - results in higher p to clear money market.
- Higher p makes home goods less competitive at given e and p^*.
- Nominal exchange rate depreciates ($e \uparrow$) to maintain competitiveness (constant rer).

Deeper insight:

$$p = m - \bar{y} + v \tag{55}$$

$$e = p - p^* \tag{56}$$

A similar equation to (55) must hold for the foreign country.

Replacing for p and p^* in equation (56) using (55) and its foreign counterpart we obtain

$$e = \underbrace{(m - \bar{y} + v)}_{p} - \underbrace{(m^* - \bar{y}^* + v^*)}_{p^*} \tag{57}$$

$$e = \underbrace{(m - \bar{y} + v)}_{p} - \underbrace{(m^* - \bar{y}^* + v^*)}_{p^*} \tag{58}$$

Implications of the monetary model:

- Nominal exchange rate is a function of the ratio (the difference if we use logs) between nominal money supply and real money demand at home and abroad.
- Depreciation if money supply at home increases more than abroad for given real money demands and appreciation if real money demand at home increases more than abroad for given money supplies.
- Nominal exchange rate is a kind of price of relative money stocks.

- The empirical evidence does not provide strong support for the above theory (surprising? Not really, it assumes perfectly flexible prices.)

- In particular, unless one assumes that (the non-modelled) velocity shocks are very volatile it cannot be reconciled with the high volatility of nominal exchange rates.

- If velocity shocks are an important determinant of the nominal exchange rate we want to endogenize them. Velocity is normally positively related to the nominal interest rate (the opportunity cost of holding money). How does the nominal interest rate enter the picture.

4.2 International asset arbitrage: CIP and UIP

International transactions in goods are not the only reason for using a foreign currency. People also buy assets internationally and no arbitrage has to be available between assets with identical characteristics[5].

A variant of LOP has to hold for assets too (returns have to be equalized in the same currency).

[5] Since arbitrage in assets is much quicker than in goods, this is also the natural place to look for the determinants of the exchange rate in the short run.

CIP (covered interest parity): forward market equilibrium condition.

$$(1 + i_t) = \frac{(1 + i_t^*)}{E_t} F_t \tag{59}$$

where i_t and i_t^* are respectively the home and foreign interest rate on assets with the same characteristics and F_t is the forward exchange rate (the number of units of home currency, contracted at time t but delivered at time $t+1$, for one unit of foreign currency at time $t+1$).

In logs CIP becomes approximately

$$i_t - i_t^* \sim f_t - e_t. \tag{60}$$

It determines the forward exchange rate given the current spot rate and the interest rate differential. The right hand side is known by the name of the forward premium.

CPI has to hold:

- Under perfect capital mobility. Capital controls may prevent arbitrage.
- Over assets with identical riskiness.
- If no risk that the counterpart to the forward contract does not deliver at time $t+1$.

If the third condition is satisfied arbitrage between the two assets is a pure bet (rather than a lottery) as the exchange rate at $t+1$ is known with certainty at time t.

What about investors that do not exchange the foreign currency in the forward market?

UIP (uncovered interest parity): spot market equilibrium condition if investors are risk neutral.

$$(1+i_t) = \frac{(1+i_t^*)}{E_t} E_{t+1}^e \tag{61}$$

which taking logs becomes approximately

$$i_t - i_t^* \sim e_{t+1}^e - e_t \tag{62}$$

- Holding a currency is in general a lottery not a pure bet as the spot exchange rate may depreciate or appreciate between t and $t+1$ $\longrightarrow$ arbitrage in assets without a forward exchange rate contract involves a risk.

- Furthermore at time $t+1$ an investor may have a preference for holding one currency rather than another one and not bearing the disutility of changing from one into the other.

- So, absent risk-neutrality or in the presence of liquidity preferences, the above condition has to hold up to a premium ρ for risk and liquidity.

$$(1+i_t) = \frac{(1+i_t^*)}{E_t} E_{t+1}^e (1+\rho_t)\,. \tag{63}$$

The log equivalent is

$$i_t - i_t^* \sim e_{t+1}^e - e_t + \rho_t \tag{64}$$

What determines changes in the spot exchange rate.

1. All else equal, higher ρ induces a currency depreciation (higher e_t) as a smaller depreciation between t and $t+1$ is necessary to induce investors to invest in the home assets at unchanged interest rate differential.

2. All else equal, a higher i_t induces an appreciation (lower e_t). If i_t is higher the only way for investors to be indifferent is if the home currency is expected to depreciate more. This requires an appreciation today.

   e.g. tomorrow the exchange rate is fixed at some rate known today (e.g. because of monetary union tomorrow) and the interest rate is changed today.

3. All else equal, expectations of a depreciation in the future (higher e_t^e) induce a depreciation today. If the exchange rate did not depreciate today, the expected depreciation between today and tomorrow would exceed the interest rate differential.

   e.g. different rates for £ entry into EMU for given interest rates today.

   As any asset price the exchange rate is a forward-looking variable. It responds to news even in the absence of changes today.

- As opposed to the monetary approach with exogenous velocity, the above condition emphasizes the forward-looking nature of the nominal exchange rate.

- The same condition also highlights a potential problem with flexible exchange rate regimes.

  Since expectations about the future value of the exchange rate affect its value today, changes in forecasts (expectations) may affect the exchange rate (sunspots, etc.). Possible indeterminacy under flexible exchange rates. If expectations are not pinned down nothing pins down $e_{t.}$ under flexible exchange rates.

- In fact there is substantial evidence that the volatility of both the forward premium and exchange rate changes increased substantially following the abandonment of the fixed exchange rate regime (Bretton Woods) most developed countries adhered to until the beginning of the Seventies.

Consider a fixed exchange regime.

- If it is fully credible $\bar{e} = e_t = e^e_{t+1}$ it implies a zero interest rate differential (because it is both $e^e_{t+1} - e_t = 0$ and $\rho = 0$ given no realignment risk) hence a zero forward premium $f_t - e_t$. Monetary policy cannot be run independently under a fixed exchange rate regime.
- Suppose it is not fully credible and the market expects a realignment with positive probability γ and, conditional on a realignment, it expects an depreciation equal to $\alpha\%$. Then it is $e^e_{t+1} = \log\{[\gamma\,(1+\alpha) + (1-\gamma)]E_t\} = \log[1+\gamma\alpha]\log E_t \sim \gamma\alpha + e_t = \gamma\alpha + \bar{e}$. Spot market equilibrium requires

$$i_t - i^*_t = \underbrace{\gamma\alpha + \bar{e}}_{e^e_{t+1}} - \bar{e} + \rho_t = \gamma\alpha + \rho_t. \tag{65}$$

- For a constant risk premium ρ_t an expected depreciation has to be associated with a higher interest rate differential and forward premium.

- A fixed exchange rate regime trades off currency volatility for interest rate volatility.

- The central bank has to set the interest rate to whatever is necessary to keep the spot exchange rate at $\bar{e}$ whatever the level of market expectations.

- If there are rule for realignments (e.g. if a realignment takes place, then it is by x%) a fixed exchange rate regime stabilizes expectations. This *unless* it is run in such a way that it is expected to collapse (e.g. Argentina).

Consider instead a flexible exchange rate regime.

We can use the forward and spot market equilibrium conditions to write

$$f_t - e_t = e^e_{t+1} - e_t + \rho_t \tag{66}$$

or

$$f_t - e_t = (e^e_{t+1} - e_{t+1}) + (e_{t+1} - e_t) + \rho_t \tag{67}$$

$$f_t - e_t = (e^e_{t+1} - e_{t+1}) + (e_{t+1} - e_t) + \rho_t \tag{68}$$

- Under flexible exchange rates not only $f_t - e_t$ and $(e_{t+1} - e_t)$ fluctuate more, but the variance of the latter term far exceed the variance of the first one. $\longrightarrow$ The variance of risk-premia and of forecast errors must explain the rest.
- The exchange rate has become more difficult to forecast. The increased uncertainty also implies a higher importance for risk premia.
- Is it possible that the increase uncertainty comes from irrationality and fickleness of forecasts? Can it be explained under the assumption of rationality?
- We need a theory of the risk premium and a theory of expectations.