5 Lecture 5: Nominal exchange rate in the long run: the modern version

Associate reading: Krugman-Obstfeld chapter 15 p. 373-379 and appendix

- The old monetary approach to the exchange rate derived in lecture 4 assumes exogenous velocity of circulation of money $\rightarrow$ nominal exchange rate: (a) fully determined by *current* relative money demands and supply and (b) independent of interest rates.

- International arbitrage in assets links interest rate differential to exchange rate and expected depreciation (UIP). How to reconcile this with the old monetary approach? What determines expectations?

- UIP (assume zero risk or liquidity premia)

$$i_t - i_t^* = e_{t+1}^e - e_t \tag{69}$$

  - $i_t \uparrow \rightarrow e_t \downarrow$, if e_{t+1}^e is unchanged. Consistent with the newspaper view that higher home rates yield to appreciation.
  - Careful! e_{t+1}^e may not stay constant if i^t changes. Relationship between the two depends on the economic causes of the change in i_t. We need a theory that links the two.

- We want to derive a model of the nominal exchange rate in the long run, allowing for the fact that people take into account the opportunity cost of staying liquid (the nominal interest rate) when deciding on how much money to hold; i.e we want to endogenize velocity.

Ingredients (same as in lecture 4 but for point 3.):

1. Some version of PPP
$$\frac{E_t P_t^*}{P_t} = K \tag{70}$$
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. Money demand negatively related to interest rate. In nominal terms,
$$M_t^d = \frac{P_t \bar{Y}_t}{V(i_t)} = P_t \bar{Y}_t e^{-\alpha i_t} \tag{71}$$
Specific functional form for velocity $V(i_t) = e^{\alpha i_t}$ with $\alpha > 0$.

- Money market equilibrium requires $M_t = M_t^d$, where M_t is nominal money supply

$$M_t = P_t \bar{Y}_t e^{-\alpha i_t} \tag{72}$$

or in logs

$$m_t = p_t + \bar{y}_t - \alpha i_t, \tag{73}$$

were αi_t corresponds to the log of velocity v_t in the previous handout.

- A similar equation must apply for the foreign country. For simplicity, assume that the (semi-)elasticity of velocity with respect to the interest rate - the parameter α - is the same in the two countries.

Equivalently

$$p_t = m_t - \bar{y}_t + \alpha i_t \tag{74}$$

- Taking logs the PPP equation (70) can be written as

$$e_t = p_t - p_t^* \tag{75}$$

- Replacing for p_t and p_t^* in equation (75) using (74) and its foreign counterpart we obtain

$$e_t = (m_t - \bar{y}_t + \alpha i_t) - (m_t^* - \bar{y}_t^* + \alpha i_t^*)\,, \tag{76}$$

$$e_t = (m_t - \bar{y}_t) - (m_t^* - \bar{y}_t^*) + \alpha\,(i_t - i_t^*) \tag{77}$$

- Still the *monetary approach to the exchange rate.* Nominal exchange rate is a function of the ratio (the difference if we use logs) between the nominal money supply and real money demand at home and abroad.

- For *given* $i_t - i_t^*$, still $m_t \uparrow \rightarrow e_t$.

- But higher $i_t - i_t^*$ results in *depreciation.* Contrary to newspaper view and UIP with exogenous e_{t+1}^e.!

- Crucial difference: i^t is an **endogenous** variable and affects money demand. We need to know its equilibrium value in order to solve for e_t.

$$\text{UIP} \qquad i_t - i_t^* = e_{t+1}^e - e_t. \tag{78}$$

- Using (78) to replace for $i_t - i_t^*$ in (76) we can write

$$e_t = (m_t - m_t^*) - (\bar{y}_t - \bar{y}_t^*) + \alpha\left(e_{t+1}^e - e_t\right). \tag{79}$$

$$e_t = (m_t - m_t^*) - (\bar{y}_t - \bar{y}_t^*) + \alpha\left(e_{t+1}^e - e_t\right). \tag{80}$$

- Same predictions as the monetary model with constant velocity. The nominal exchange rate is effectively the price of relative money supplies net of demands.
- Only difference: the current spot exchange rate depends not only on current fundamentals $(m_t - m_t^*) - (\bar{y}_t - \bar{y}_t^*)$ but also on the expected change in the exchange rate between today and tomorrow (forward-looking).
- This is because money demand is forward-looking, as it depends on the interest rate between today and tomorrow.

- A higher expected depreciation (i.e. an increase in $e^e_{t+1} - e_t$) implies a depreciation of the exchange rate today.
- Intuition: a higher expected depreciation requires a higher interest rate differential (equation (78)) to avoid arbitrage. A higher nominal interest rate reduces real money demand, hence for a given nominal money supply the home price level has to rise to reestablish money market equilibrium. This requires a depreciation of the nominal exchange rate to keep the real exchange rate at its equilibrium PPP level.

Important: the monetary model predicts that a higher nominal interest rate is associated with a depreciation of the current spot exchange rate. Why?

This is not a theory of the e_t unless we specify how expectations e^e_{t+1} and the interest rate differential are determined.

5.1 Endogenous rational expectations

What determines the expected future change in the nominal exchange rate? Equation (80) has two unknowns e_t and e^e_{t+1}. In order to determine e_t, we need an equation for expectations.

We assume **rational expectations.** Agents use all the information available (including the model that describes the economy; i.e. our equation (80)) when forming their expectations. If there is no uncertainty rational expectations are equivalent to **perfect foresight**; i.e. agents expectations about the future exchange rate coincide with its true future value. The equations that determines expectations is

$$e^e_{t+1} = e_{t+1}. \tag{81}$$

Hence, $e^e_{t+1} - e_t = e_{t+1} - e_t = \Delta e_{t+1}$ where $\Delta e_{t+1} = e_{t+1} - e_t$.

Replacing in (80) we obtain

$$e_t = (m_t - m_t^*) - (\bar{y}_t - \bar{y}_t^*) + \alpha \Delta e_{t+1} \tag{82}$$

PPP - equation (75) implies

$$\Delta e_{t+1} = p_{t+1} - p_t - (p_{t+1}^* - p_t) = \pi_{t+1} - \pi_{t+1}^*. \tag{83}$$

For a small country that takes foreign variables as given, equations (82) and (83) form a system of two equations in the three endogenous variables $\{e_t, \Delta e_{t+1}, \pi_{t+1.}\}$. We need one more equation.

Assumption: we restrict attention to equilibria in which the rate of growth of money is constant. It can be changed, but stays constant after the change.

In an equilibrium in which money grows at a constant rate μ prices grow at the same rate; i.e.

$$p_{t+1} - p_t = m_{t+1} - m_t = \mu \tag{84}$$

or

$$\pi_{t+1} = m_{t+1} - m_t = \mu. \tag{85}$$

and replacing in (83)

$$\Delta e_{t+1} = \mu - \pi^*_{t+1}. \tag{86}$$

Putting it all together

$$e_t = (m_t - m_t^*) - (\bar{y}_t - \bar{y}_t^*) + \alpha \Delta e_{t+1} \tag{87}$$

$$\Delta e_{t+1} = \mu - \pi_{t+1}^*. \tag{88}$$

Two possible types of permanent policy changes:

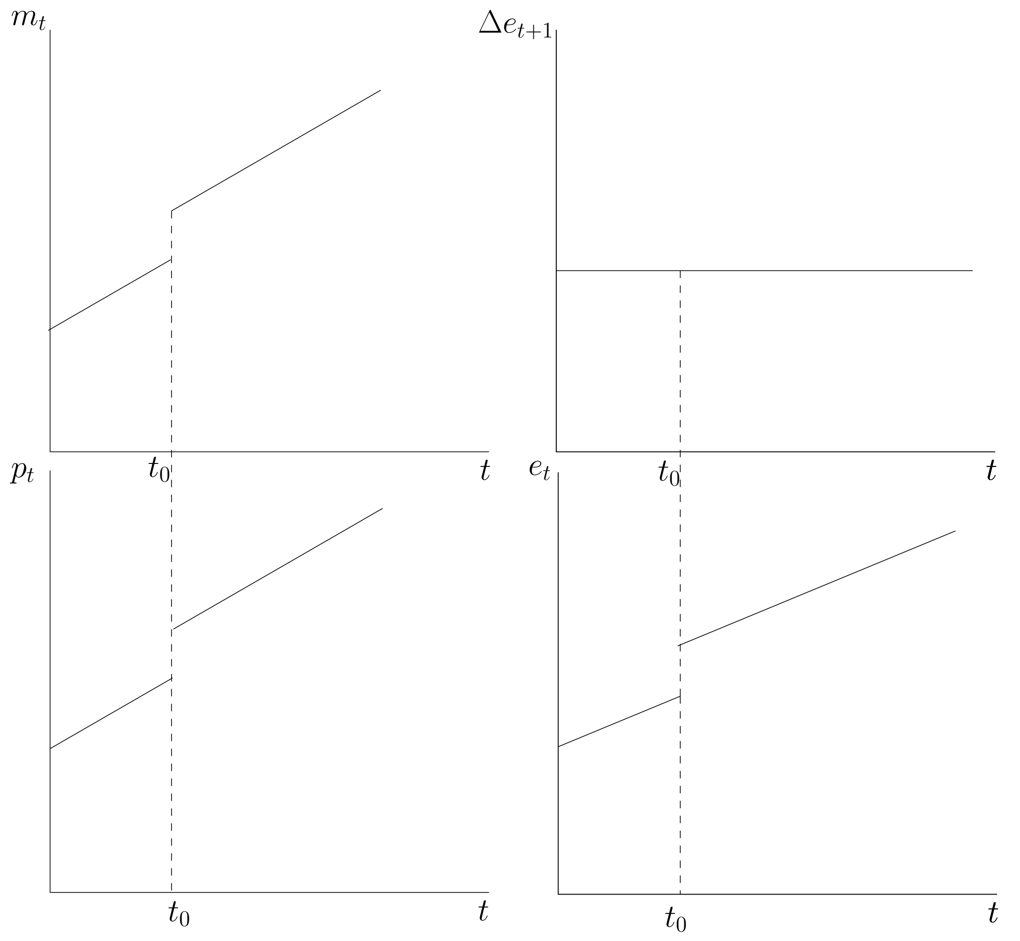
1. Permanent change in the **current level** of the money supply m_t.

2. Permanent change in the **rate of growth** of the money supply.

5.1.1 Permanent change in the money supply level.

m_t is raised, but its rate of growth is unchanged. See Figure on following page.

- Δe_{t+1} unchanged. So $i_t = i_t^* + \Delta e_{t+1}$ unchanged. Velocity and real money demand unchanged.
- $e_t \uparrow$. As nominal money supply $m_t \uparrow$, for the real money supply to be unchanged $p_t \uparrow$ and from PPP $e_t \uparrow$.
- Same as under old monetary model (as velocity is unchanged in equilibrium).

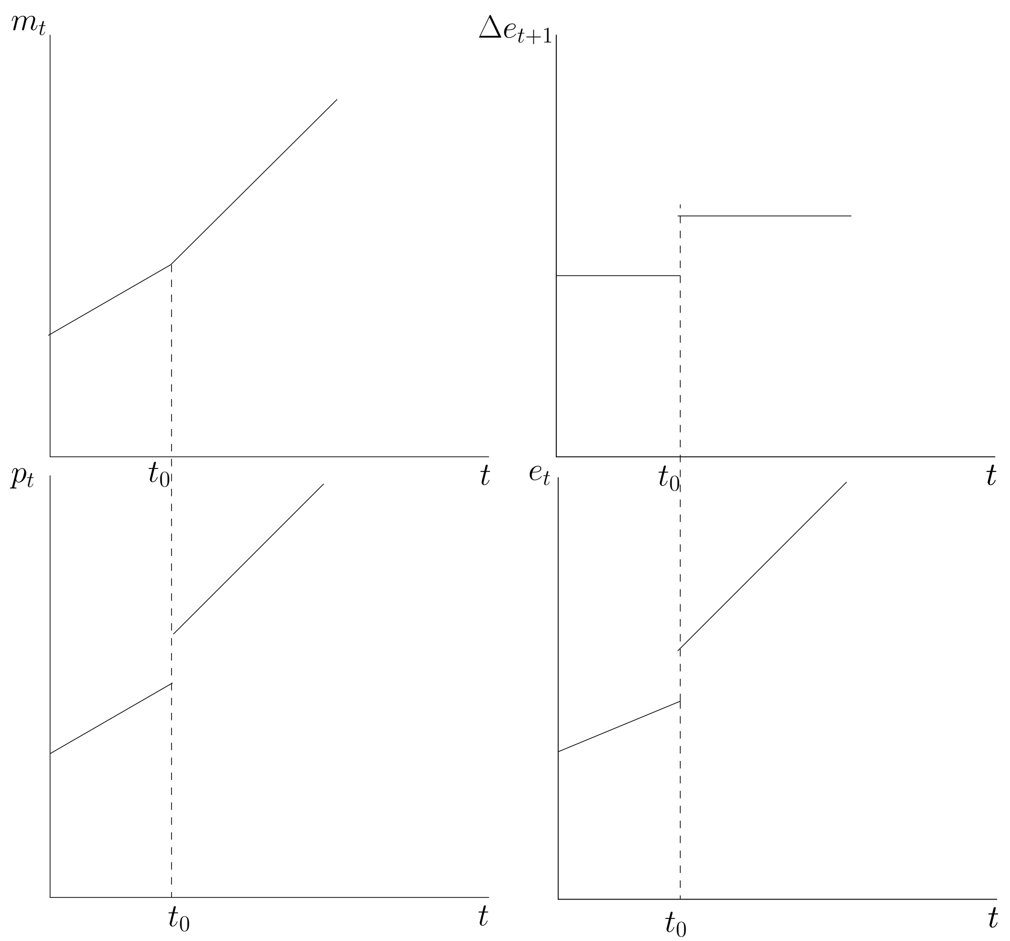


m_t
Δe_{t+1}
p_t
t_0
t
e_t
t_0
t
t_0
t
t_0
t

5.1.2 Permanent change in the money growth rate.

μ is raised, but not current m_t. See Figure on next page.

- $\Delta e_{t+1} \uparrow$. So $i_t = i_t^* + \Delta e_{t+1} \uparrow$. Velocity increases, hence real money demand falls, as opportunity cost of holding home money has increased.
- $e_t \uparrow$. As real money demand has fallen but nominal money supply m_t is unchanged. For the real money supply to fall $p_t \uparrow$ and from PPP $e_t \uparrow$.
- Novelty relative to old monetary model. Expectations about the future matter.
- With flexible prices, higher home interest rates result in a depreciation of the home currency. Contrary to newspaper view.


m_t
t_0
t
Δe_{t+1}
t_0
t
p_t
t_0
t
e_t
t_0
t

5.2 News, announcement and credibility

1. *Future changes* in fundamentals affect the current equilibrium value of the exchange rate;

2. so do *expectations* of future changes in fundamentals;

3. in so far as they alter expectations *announcements* of future changes in fundamentals affect the current nominal exchange rate;

4. hence, the credibility of announcements of future policy changes matters.

- Fully credible (fully believed) announcement. Suppose now that at the beginning of time t the government announces that it will halve the money growth rate permanently. The announcement is fully believed. The outcome is the same as in the previous case.

- Non-credible (not fully believed) announcement. Suppose now that at the beginning of time t the government announces that it will halve the money supply growth rate permanently. The announcement is not believed (i.e. the public assume the money growth rate is unchanged with probability one). This implies $\Delta e_{t+1} = 0$ and has no effect on the exchange rate.

- Exchange rate reacts (jumps in response) to all unexpected changes (news) in present or future fundamentals. It changes smoothly otherwise since all expected changes are already embodied in expectations.

- This more recent version of the monetary approach to the exchange rate due to Mussa (1976) and Frenkel (1976) is important in so far as it emphasizes the forward-looking aspect of the exchange rate. It is extremely useful to study issues like the effect of announcements, changes in expectations, speculative attacks and in general as a theory of the nominal exchange rate in the long run.

- Some limitations. Approach has nothing to say about the relationship between the exchange rate and the current account. With perfectly flexible prices, the current account is determined by the same real factors that determined equilibrium output, the equilibrium real exchange rate and saving/investment. Money is neutral and determines nominal variables: the price level and the nominal exchange rate. In such a world, the nominal exchange rate moves in line with prices in the absence of changes in risk premia or the equilibrium real exchange rate.