ECON 3123: Macroeconomic Theory I

Tutorial Note 9: Financial Market and Goods Market in Open Economy

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Exchange Rate

The **nominal exchange rate** is the price of domestic currency in terms of foreign currency, denoted by E. An **appreciation** of the domestic currency means that the domestic currency becomes more expensive relative to the foreign currency, i.e., E increases. A **depreciation** of the domestic currency means that the domestic currency becomes cheaper relative to the foreign currency, i.e., E decreases.

Example 1 (Cross rates and triangular arbitrage). *Suppose that the nominal exchange rate is 2.5 USD/GBP in year 0. One year later, this rate becomes 2.0 USD/GBP. In year 0, the nominal exchange rate between GBP and EUR is 1.25 EUR/GBP, and EUR appreciated by 10% against USD in 1 year.*

(1) What is the appreciation/depreciation rate of USD against GBP? What about GBP against USD?

(2) What must the exchange rate between EUR and USD be to avoid arbitrage in year 0? Denote it as the price of EUR in terms of USD.

(3) Suppose that the exchange rate between EUR and GBP is 1.1 EUR/GBP in year 1. Is there any arbitrage opportunity? Suppose that you are holding 1,000,000 GBP in year 1.

Exercise 1. *Assume you are a trader with Deutsche Bank. From the quote screen on your computer terminal, you notice that Dresdner Bank is quoting 0.7627 EUR/USD and Credit Suisse is offering 1.1806 CHF/USD. You learn that UBS is making a direct market between the Swiss franc and the euro, with a current EUR/CHF quote of 0.6395. Show how you can make a triangular arbitrage profit by trading at these prices. Assume you have $5,000,000 with which to conduct the arbitrage. What happens if you initially sell dollars for Swiss francs (CHF)? What EUR/CHF exchange rate will eliminate triangular arbitrage?*

International Parity Conditions No-arbitrage condition leads to a set of conditions that must be satisfied between currencies. These conditions are called **international parity conditions**.

We learnt in class the following **uncovered interest parity relation** (UIP):

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

Consider a **forward contract** which is an agreement to buy and sell foreign currencies in the future ($t + k$) at prices agreed upon today (t) denoted by $F_{t,t+k}$. Then we can predict E_{t+1}^e by $F_{t,t+1}$. This leads to the **covered interest parity relation** (CIP):

$$1 + i_t = (1 + i_t^*)\frac{E_t}{F_{t,t+1}}.$$

What is *covered* here? The exchange rate risk. By using a forward contract, the agent already locks the future exchange rate, which avoids uncertainty. However, in the UIP relation, this term is only one expectation, which essentially has no hedging effect.

Example 2. *Suppose that the 1-year interest rate is 1% in USD and 3% in GBP. The exchange rate is 1.5 USD/GBP. Suppose you want to buy or sell 1,000,000 GBP now.*

(1) What should be the 1-year forward rate to avoid arbitrage?

(2) *You predict that the actual exchange rate will be 1.5 USD/GBP in 1 year. What should you do?*

(3) *You predict that the actual exchagne rate will be 1.4 USD/GBP in 1 year. What should you do?*

Real Exchange Rate The **real exchange rate** is the price of domestic goods in terms of foreign goods, denoted by ϵ:

$$\epsilon = E\frac{P}{P*}.$$

The real exchange rate can be very different from the nominal exchange rate depending on the inflation rate in each country. Think about the following case:

Example 3. *Consider the exchange rate* $E = 7.8$ *HKD/USD. Suppose that iPhone 20 is sold at 1,500 USD and 10,000 HKD.*

(1) *What is the real exchange rate?*

(2) *Where will you prefer to buy the iPhone 20? Can you make a profit? Assume that the phone does not depreciate.*

(3) *At what real exchange rate will you be indifferent between buying it in the US and in Hong Kong?*

You can see that there will be arbitrage opportunity if the real exchange rate is not 1. This motivates another international parity condition: **purchsing power parity** (PPP).

There are two versions of purchasing power parity. The first version is called the **absolute PPP**, which is directly from the concept of real interest rate:

$$\epsilon = 1, \quad \text{or equivalently,} \quad E = \frac{P^*}{P}.$$

The second version is called the **relative PPP**:

$$\frac{E^e_{t+1}}{E_t} = \frac{1 + \pi^{*e}_{t+1}}{1 + \pi^e_{t+1}}.$$

It is a good exercise to show this by yourself and it is not hard.

Exercise 2. *Show the relative PPP relation.*

Recall that we have the Fisher equation:

$$1 + i_t = (1 + r_t)(1 + \pi^e_{t+1}).$$

If $r_t = r^*_t$, then we get the **international Fisher equation** (IFE):

$$\frac{1 + i^*_t}{1 + i_t} = \frac{1 + \pi^{*e}_{t+1}}{1 + \pi^e_{t+1}}.$$

Combining PPP, IFE, and CIP, we have

$$\frac{E^e_{t+1}}{E_t} = \frac{1 + \pi^{*e}_{t+1}}{1 + \pi^e_{t+1}} = \frac{1 + i^*_t}{1 + i_t} = \frac{F_{t,t+1}}{E_t}.$$

The resulting parity

$$\frac{E^e_{t+1}}{E_t} = \frac{F_{t,t+1}}{E_t}$$

is called the **forward expectation parity** (FEP).

Exercise 3. *Suppose that when you trade foreign currencies, there will be a transaction fee* $T = \tau X$*, where* X *is your transaction amount. Which of the above relation(s) (i.e., UIP, CIP, PPP, IFE, FEP) cannot hold? Show your proof.*