TOPIC 7: FOREIGN EXCHANGE*

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This lecture introduces foreign exchange rates and exchange markets. It helps you understand how exchange rates are determined and what accounts for their fluctuation over time. Exchange rate is a key tool that makes international trade possible. Since buyers and sellers both want to use their own currencies, there must be an exchange of currencies. The exchange rate is the price of one currency in terms of another. It has implications for countries and individuals; long swings or sudden spikes in exchange rates affect the costs of different goods in different countries.

1 FOREIGN EXCHANGE BASICS

We first look at the definitions of nominal and real exchange rates.

The nominal exchange rate. Let E be the **nominal exchange rates** between two currencies, which can be quoted in two ways: first, as the price of the domestic currency in terms of the foreign currency; second, as the price of the foreign currency in terms of the domestic currency. We shall adopt the fist definition. For example, if dollar is the domestic currency and pound is the foreign currency, the exchange rate between the U.S. and the U.K., E, denotes the price of a dollar in terms of pounds. Exchange rates change everyday:

- A **nominal appreciation** (an increase in E) of the domestic currency is an increase in the price of the domestic currency in terms of a foreign currency.
- A **nominal depreciation** (a decrease in E) of the domestic currency is a decrease in the price of the domestic currency in terms of a foreign currency.
- When countries operate under **fixed exchange rates**–a system in which two or more countries maintain a constant exchange rate between their currencies–increases in E are called **revaluations** and decreases in E are called **devaluations**.

The real exchange rate. We construct the **real exchange rate** between the U.S. and the U.K.–the price of U.S. goods in terms of British goods. Let P be the GDP deflator for the U.S.,

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Disclaimer: these are notes that I used by myself to lecture from and for educational purposes only. The material presented here is largely based upon the undergraduate textbook by Stephen Cecchetti and Kermit Schoenholtz (2014), *Money, Banking and Financial Markets*, 4th Edition, McGraw-Hill/Irwin. Please do NOT circulate.

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P^* be the GDP deflator for the U.K., and E be the dollar-pound nominal exchange rate. See Figure 1.1 below. The real exchange rate ϵ is thus given by

$$\epsilon = \frac{EP}{P^*} = E\frac{P}{P^*} \tag{1.1}$$

which is an index number because the GDP deflators are themselves index numbers.[1] Real exchange rates also move over time:

- An increase in the relative price of domestic goods in terms of foreign goods (an increase in ϵ) is called a **real appreciation**.
- A decrease in the relative price of domestic goods in terms of foreign goods (a decrease in ϵ) is called a **real depreciation**.
- Not only the nominal and the real exchange rate can move in opposite directions, but also the real exchange rate inherits the large fluctuations in the nominal exchange rate.[2]

Figure 1.1 The construction of the real exchange rate

Supplementary: uncovered interest parity condition. Consider, for example, the choice between U.S. (domestic) one-year bonds and U.K. (foreign) one-year bonds, from the point of view of a U.S. investor. Let E_t be the nominal exchange rate between the dollar and the pound and i_t^* be the one-year nominal interest rate on U.K. bonds.

- For every dollar we put in U.S. bonds, we get $(1 + i_t)$ dollars next year. For every dollar we put in U.K. bonds, it buys us E_t pounds today and we get $E_t(1 + i_t^*)$ pounds next year. Since we expect the nominal exchange rate next year to be E_{t+1}^e, we expect to receive $E_t(1 + i_t^*)/E_{t+1}^e$ dollars next year.

[1] Although the level of the real exchange rate is uninformative, its rate of change is informative: if, for example, the real exchange rate between the U.S. and the U.K. increases by 10%, this tells us U.S. goods are 10% more expensive relative to British goods than they were before.

[2] As equation (1.1) suggests, if the decrease in P/P^* ia larger than the increase in E, ϵ will decrease, leading to both a nominal appreciation and a real depreciation. Moreover, because movements in P/P^* are typically small compared to movements in E, movements in ϵ tend to be driven mostly by movements in E.

- Assume that we, and other financial investors, care only about the expected rate of return. Because of arbitrage, the following relation must hold:

$$1 + i_t = (1 + i_t^*) \left(\frac{E_t}{E_{t+1}^e} \right) \tag{1.2}$$

  which is called the **uncovered interest parity condition**.

- The above analysis ignores two factors: first, the transaction costs associated with going in and out of U.K. bonds;[3] second, the risk of holding U.K. bonds because of the uncertain exchange rate next year. Rearranging equation (1.2) gives

$$1 + i_t = \frac{1 + i_t^*}{1 + (E_{t+1}^e - E_t)/E_t} \tag{1.3}$$

  and a useful approximation of the above equation is given by

$$i_t \approx i_t^* - \frac{E_{t+1}^e - E_t}{E_t} \tag{1.4}$$

  which is a relation between the domestic nominal interest rate i_t, the foreign nominal interest rate i_t^*, and the expected rate of appreciation of the domestic currency $(E_{t+1}^e - E_t)/E_t$, or equivalently, the expected rate of depreciation of the foreign currency.[4] We apply this equation to U.S. bonds versus U.K. bonds:

  - Suppose $i_t = 2\%$ in the U.S. and $i_t^* = 5\%$ in the U.K. The choice between U.S. bonds and U.K. bonds depends on whether we expect the pound to depreciate relative to the dollar by more or less than $i_t^* - i_t = 3\%$ over the coming year.
  - If we expect the pound to depreciate by more than 3%, investing in U.S. bonds is more attractive; if we expect the pound to depreciate by less than 3%, investing in U.K. bonds is more attractive.
  - As equation (1.4) suggests, if two countries commit to maintaining their bilateral exchange rates at a fixed value and markets have faith in this commitment, $E_{t+1}^e = E_t$ and the arbitrage condition implies that $i_t \approx i_t^*$.

[3] It requires three separate transactions: first, one must buy pounds using dollars; second, one buys U.K. bonds using pounds; third, one must convert pounds back into dollars.

[4] If, for example, $i_t^* - i_t = 3\%$ and the uncovered interest parity condition holds, it must be that financial investors are expecting, on average, an appreciation of the dollar relative to the pound of 3% over the coming year.

2 EXCHANGE RATES IN THE LONG RUN

We next look at how nominal exchange rates are determined in the long run, e.g. decades.

The law of one price. The basis of **law of one price** is the concept of **no arbitrage**, the idea that identical products should sell for the same price. For example, let E denote the exchange rate between the U.S. and Canada. Suppose a TV that sells for $\$P_{\text{Detroit}}$ U.S. dollars in Detroit sells for $\$P_{\text{Windsor}}$ Canadian dollars in Windsor. Then the law of one price says that

$$\$P_{\text{Windsor}} = \$P_{\text{Detroit}} \times E \tag{2.1}$$

which can fail easily in the short run due to, e.g. transportation costs, tariffs, etc.

Purchasing power parity. The theory of **purchasing power parity (PPP)** is an extension of the law of one price. It states that the dollar price of one basket of goods and serves in the U.S. should be the same as that anywhere in the world.

- In the U.K. case, the PPP condition becomes

$$1 = \frac{\text{dollar price of one basket in U.S.}}{\text{dollar price of one basket in U.K.}} = \frac{P}{P^*/E} = \epsilon \tag{2.2}$$

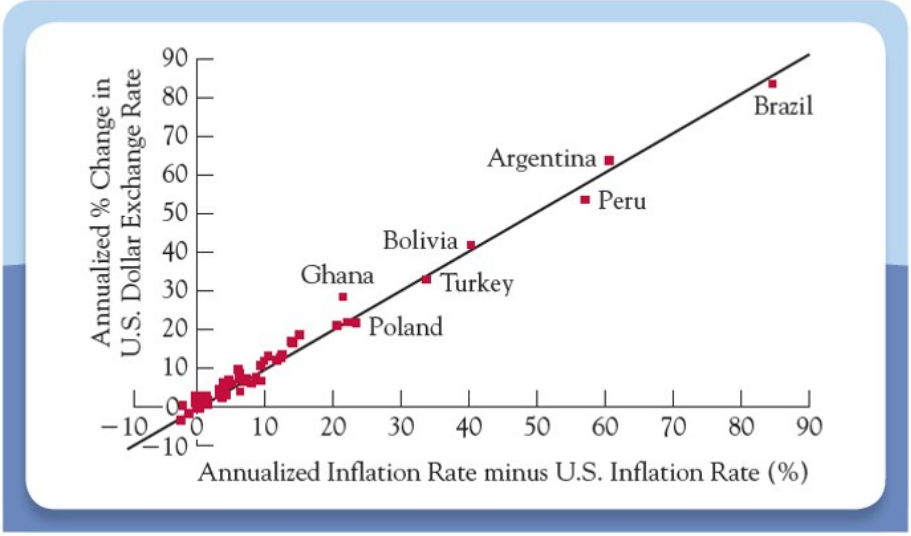
  That is, the real exchange rate is always equal to one, meaning that the purchasing power of one dollar is the same all over the world.

- Rearranging (2.2) gives

$$\underbrace{E}_{\text{pounds per dollar}} = \frac{\text{pound price of one basket in U.K.}}{\text{dollar price of one basket in U.S.}} = \frac{P^*}{P} \tag{2.3}$$

  which implies that changes in exchange rates are tied to differences in inflation from one country to another. In particular, the currency of a country with high inflation will depreciate. See Figure 10.4 below.

Figure 10.4 Exchange Rate Movements and Inflation Differentials, 1980–2010

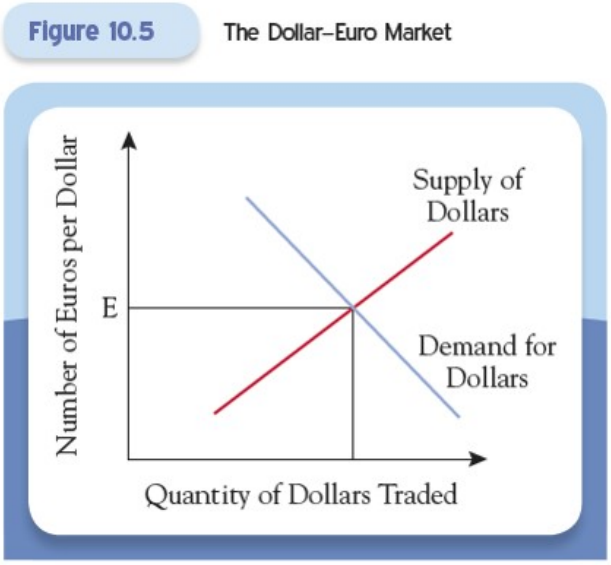


3 Exchange Rates in the Short Run

We finally turn to an analysis of the supply and demand for currencies to see how nominal exchange rates are determined in the short run, e.g. weekly, monthly, etc.

The supply, demand, and equilibrium in the dollar market. We pick the U.S. as the domestic country.

- There are two reasons that dollar holders want to exchange dollars for foreign currencies: [i.] to purchase goods and services produced abroad; and [ii.] to invest in foreign assets. The higher the price a dollar commands in the market, the more dollars supplied. Thus, the supply curve for dollars slopes upward.
- Foreigners who want to purchase U.S. goods, services, and assets need dollars. The lower the price a dollar commands in the market, the more dollars demanded. Thus, the demand curve for dollars slopes downward.
- The equilibrium exchange rate equates the supply and demand of dollars. See Figure 10.5 below.



Shifts in the supply and demand of dollars. The list below includes various possibilities that shift the supply curve to the right, leading to a depreciation of dollars:

- Increase in Americans' preference for foreign goods.
- Increase in the real interest rate on foreign bonds (relative to U.S. bonds).
- Increase in American wealth.
- Decrease in the riskiness of foreign investments relative to U.S. investments.
- Expected depreciation of the dollar.

A similar list, from the perspective of foreigners, shifts the demand curve to the right, leading to an appreciation of dollars.

4 Government Policy and Foreign Exchange Intervention

Assigned as reading.